Chapter 2

Chapter 2

2. ALTERNATIVES INCLUDING THE PROPOSAL

2.1 INTRODUCTION

This chapter describes and compares the Preferred Alternative and five other forest management Alternatives and outlines the processes used by the Board of Natural Resources (Board) to develop the Preferred Alternative. The final decision by the Board will define sustainable forest management and the associated sustainable harvest level that will be achieved for forested trust lands in western Washington.

Section 2.2 reviews the policy, procedure, and implementation strategies contained in the Alternatives. Section 2.3 briefly describes the computer modeling process used to analyze the Alternatives and updates to the modeling since publication of the Draft EIS. Section 2.4 addresses the development of the six forest management Alternatives. Section 2.5 discusses Alternatives that were considered but eliminated from detailed study in the Environmental Impact Statement because they did not meet the purpose and need of the project. Section 2.6 describes and reviews the Preferred Alternative in contrast with the other five Alternatives.

2.2 POLICIES, PROCEDURES, AND IMPLEMENTATION STRATEGIES

DNR serves as manager of approximately 1.4 million acres of forested state trust lands in western Washington. Except for the State Natural Area Preserves and the Natural Resource Conservation Areas, these forestlands are managed in trust. Over the short and long term,

DNR's fiduciary responsibility is to maintain the body of the forested trust lands with undivided loyalty to the designated beneficiaries, and generate revenue from those forested trust lands for those beneficiaries. In order to meet obligations to all generations of beneficiaries, DNR must carry out land management that strikes the appropriate balance between current and future income production and the long-term preservation of trust assets. In addition to trust obligations, DNR is subject to a number of federal and state statutes that protect public resources and provide public benefits. To fulfill these mandates, there are governing policies, procedures, and strategies for management of forested trust lands.

- The Board of Natural Resources sets the major policies for DNR-managed state lands.
- DNR develops administrative procedures to effectively and efficiently implement Board-approved policies.
- DNR retains the flexibility in its field operations to respond to changing or unique circumstances with specific implementation strategies.

As stated in Section 1.3, the sustainable harvest calculation gives the Board and DNR an opportunity to examine the policies and procedures. The State Environmental Policy Act requires DNR to examine potential environmental impacts of reasonable Alternatives consistent with the purpose and need statement. Six Alternatives were prepared by grouping various combinations of policy changes that represented different approaches to achieving the desired results. The State Environmental Policy Act stipulates that DNR analyze only probable adverse environmental impacts that are significant, and that such analyses be based on reasonably available information. The level of detail of the analysis is to be commensurate with the importance of the impact, with less important material summarized, consolidated, or referenced (Washington Administrative Code 197-11-402).

Once Alternatives were defined, DNR used several analytical tools to evaluate each Alternative to understand the short- and long-term consequences of such actions. These include either formal or informal analyses of costs and revenue, stakeholder interests and concerns, operational feasibility, and the environmental analysis contained in this document.

2.2.1 Transition and Implementation

The Alternatives identified the potential of the forested trust lands to produce financial, ecological, and social benefits. To achieve the potential of any of the Alternatives, there are a number of operational and administrative considerations. For example, Alternatives that demonstrate higher harvest levels than today, such as the Preferred Alternative, will require additional foresters and specialists to successfully implement the Alternative. Therefore the ability to hire, train, and pay for these extra staffing needs and other operational considerations is part of the implementation of an Alternative.

Recent annual harvest levels have been lower than the average sustainable harvest level estimated in 1997 after the DNR's Habitat Conservation Plan was adopted. Harvest levels have been lower for several reasons, including: 1) protected riparian and marbled murrelet areas that were more extensive than originally estimated; 2) a cautious early approach to

implementation based on threatened litigation; and 3) temporary restrictions imposed on harvesting, beyond those envisioned in the Habitat Conservation Plan, as an ecological precaution for the first decade of the implementation. As a result, transitioning to a new higher harvest level, such as with the Preferred Alternative, entails building up capacity in the short term.

Recognizing that a transition period is likely to reach a higher harvest level, the Board of Natural Resources directed the DNR to "present an analysis….that identifies hiring, implementation timelines and cash flow necessary to transition to the Preferred Alternative management practices and associated harvest levels. The Department is directed to prepare a Preferred Alternative that shall meet an average annual harvest target of 636 million board feet as soon as possible" (Board of Natural Resources Resolution 1110). This unanimously approved resolution also directed DNR to start the Final Environmental Impact Statement (EIS).

In May 2004, DNR presented to the Board a detailed harvest transition plan. In that presentation, DNR explained the budget, cash-flow, hiring and other operational considerations that would limit DNR's ability to immediately start harvesting at the new anticipated higher sustainable level.

As part of the transition plan, DNR would shorten the duration of timber sales contracts to accelerate revenues to help fund the transition. Cost savings, such as region reorganization and other structural changes, have been implemented that will allow DNR to achieve the 636 million board feet harvest level within 5 years. If possible, DNR will meet this level sooner, attempting to meet the clear intent of Section 5 of the Board's resolution.

The Final EIS analyzes environmental impacts of a first decadal harvest of 6,360 million board feet for the Preferred Alternative. The transition schedule presented to the Board shows a total of 5,900 million board feet, with a mean annual first decadal level of 590 million board feet per year.

2.2.1.1 Linking Plans to Timber Sales

The Forest Resource Plan and 1997 Habitat Conservation Plan (HCP) provide a policy framework for the DNR to implement its policy direction through a series of planning processes, such as landscape planning and timber harvest scheduling (see Figure 2.2-1). The Habitat Conservation Plan developed management strategies at the landscape level and utilizes five western Washington HCP Planning Units and the Olympic Experimental State Forest as management areas on which to set performance standards and reporting functions.

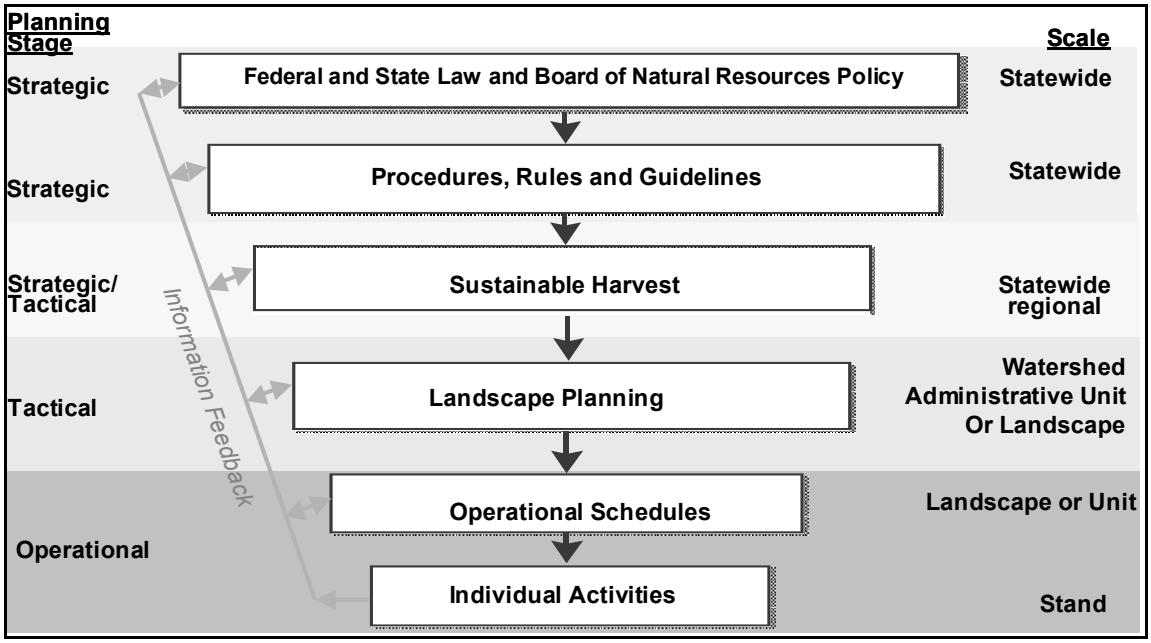

Figure 2.2-1. Hierarchical Planning Model

When the Board ultimately adopts a Preferred Alternative and associated sustainable harvest level, DNR would incorporate implementation planning for the adopted Alternative concurrently with its programs of landscape planning and timber harvest scheduling. Information from these planning exercises, in conjunction with specific Habitat Conservation Plan reporting should provide much of the information for a structured reporting program on the implementation of the Preferred Alternative.

2.3 SUSTAINABLE FOREST MODELING AND THE EIS

There are several key outcomes of the sustainable harvest modeling analyses. They range from an understanding of the anticipated conservation benefits to the projected levels of sustainable harvests of trees. A key expectation of the modeling is to determine the volume of trees that can be harvested on a continuing basis without major prolonged curtailment or cessation of harvest (Revised Code of Washington 79.10.310). The western Washington forested state trust lands under DNR's jurisdiction are primarily valuable for growing forests on a sustained yield basis. In determining the sustainable level of harvest, DNR incorporates statutes and options for policies, procedures, and operations that could affect management on the forested trust lands for decades to come.

The foundations of a sustainable harvest calculation are: 1) an inventory of the forest including age and species; 2) a thorough understanding of various options available for managing the forest to achieve goals (to be defined through policies and procedures that form a management approach or Alternative); and 3) a way to calculate potential outcomes of various strategies, which is facilitated using a computer model. The model helps one to organize and analyze information. The sustainable harvest model was designed to inform the Board of Natural Resources during their decision-making regarding key forest

management policies, and to provide information for the DNR to recommend an associated sustainable harvest level with the Board's key policy decisions. The model's major purpose is to provide information to assist in understanding and being able to compare the changes in forest inventory, habitat conditions, and timber harvest that result from the various Alternatives over the next 64 years (the remainder of the 70-year term of the Habitat Conservation Plan).

The term "model" (as used in this document) denotes a process by which a suite or set of policy preferences are expressed in computer language and are simulated through a process of modeling software. The outputs of this modeling process are estimates of forest inventory, harvest, stand development stage, revenue, and costs. Included in DNR's modeling process is modeling software called OPTIONS. OPTIONS is a spatially explicit, land-based planning model that has been designed specifically to address forestland management issues. OPTIONS can model "what happens, where it could happen in the landscape, and show how it would change over time." This model simulates forest growth over time, tracking where management activities could happen, and gives DNR the ability to view detailed changes in the forest inventory and conditions over time and space. This ability to track spatially where activities could happen facilities ground-truthing and to a certain extent tests the feasibility of a model run. Although the modeling process provides much useful information for policy analysis, it does not provide an operational harvest schedule. Simply put, the modeling process is to the DNR's forest planning as a flight simulator is to Boeing.

The sustainable harvest modeling process was not specifically designed to provide information for an environmental analysis. However, many of the modeling outputs, such as forecasting the changes in forest inventory and habitat conditions under different Alternatives, provide useful information that can assist in confirming expected impacts of proposed changes in policies and procedures. Modeling outputs are presented in this environmental analysis alongside other information—both qualitative (such as expected outcomes derived from readings of current literature, expert opinion, and public comment) and quantitative (such as data on current conditions or relevant research studies). The Board's decision-making process also relies on information generated during the State Environmental Policy Act analysis and public involvement processes.

Revised Code of Washington (RCW) 79.10.320 requires that "the Department shall periodically adjust the acreages designated for inclusion in the sustained yield management program and calculate a sustainable harvest level." The model relies on the best and most complete acreage and forest inventory information available. Forest inventories are updated with current tree growth models and data from Geographic Information Systems, provided by a variety of sources including on-the-ground foresters and records of harvest planning, sales, and other management activities. This information has improved since the last calculation in 1996.

John Sessions, a renowned forest engineering scientist from Oregon State University, informed the Board of Natural Resources (November 2001) that there are four steps to credibility and operational success in building a forest model to derive a sustainable harvest level:

1. Represent organizational goals and constraints accurately in the model;
2. Use an adequate vegetation inventory;
3. Choose an appropriate land classification; and
4. Link strategic planning to implementation.

DNR followed these steps in modeling the sustainable harvest Alternatives presented in this Environmental Impact Statement. DNR seeks to carry out each step as it proceeds through the sustainable forestry calculation process, as well as while implementing the new harvest level once it has been established.

2.3.1 Modeling Updates

Since the distribution of the Draft modeling results on June 25, 2003 and the Draft Environmental Impact Statement (EIS) in November 2003, DNR has made a series of updates to the modeling process. These updates were made in part as a response to comments made by DNR region field staff and by public comments on the Draft EIS. Two areas of the modeling were updated: 1) the estimates of saleable timber volume (in Scribner board feet) and 2) the stand development stage modeling.

The update to the estimates of saleable volume, particularly for the value-based Alternatives (Alternative 5 and the Preferred Alternative; see 2.6.3.2 Timber Harvest Levels) was in response to concerns from the technical review committee and DNR field staff that the estimated yields in the Draft EIS were too high. Review of the modeling processes and estimates led to changes in how DNR estimated the growth and yield and inventory characteristics of existing older forest stands. These updates to the growth and yield aspects of the value-based models, detailed in Appendix B, resulted in the need to review the logic of the stand development stage modeling.

In addition, public comments on the Draft EIS and from the technical review committee suggested that the stand development stage modeling reported in the Draft EIS accelerated stands too quickly through the development stages. This trend was particularly noted for forest stands on a natural, no-management pathway. The stand development stage classification system was reviewed and changes were made to the system to reflect a more realistic prediction of stand development under a no-management scenario. The details of the changes are in Appendix B. These changes were incorporated into the modeling of the Alternatives presented in this Final EIS.

2.3.2 Uncertainty in the Modeling Results

The implementation of the Board's selected Alternative and harvest level will be a test of modeling assumptions. Implementation will provide feedback for refining DNR's planning process. The Board, in Resolution 1110, anticipated this aspect and requested a regular and structured reporting program.

During the design and model analysis, DNR included a number of reviews of modeling outputs with field staff and the technical review committee. However, with modeling, uncertainties exist, and not all can be quantified or identified clearly. The three general areas of modeling uncertainty are the estimates of:

- saleable timber volume (Scribner board feet),
- available harvestable area, and
- changes in forest conditions from one stand development stage to another.

To illustrate the first of these two points, assume that an average of 60 years between regeneration harvest would be implemented on a forest base of 1 million acres. To calculate the sustainable harvest level, divide the 1 million acres by 60, resulting in approximately 16,700 acres of harvest per year. These 16,700 acres are assumed to yield on average 35 thousand board feet Scribner an acre, resulting in a harvest level of 585 million board feet per year.

Note: 1 million acres / 60-year rotation = 16,700 acres harvested per year
16,700 acres x average yield of 35 thousand board feet per acre = 585 million board feet per year.

As illustrated in Table 2.3-1, an approximate 10 percent reduction either in yield or area on-base for timber harvesting would result in a corresponding approximate 10 percent reduction in harvest level.

2.3.2.1 Uncertainty in Harvestable Volume

The estimate of saleable timber volume is a complex but key assumption in DNR's modeling process, because the purpose of the sustainable harvest calculation is to recommend a sustainable harvest level that will be offered for sale (RCW 79.10.340). Uncertainty exists because the volume used to advertise a timber sale is not the same as the volume from the forest inventory, even though both can and typically are described in

Table 2.3-1. A Simple Harvest Model

Assumptions	Base	10 Percent less yield	10 Percent fewer acres
On-base acres	1,000,000	1,000,000	900,000
Average rotation length	60	60	60
Average expected yield (thousand board feet per acre) of saleable timber	35	32	35
Annual areas harvested	16,700	16,700	15,000
Annual sustainable harvest level (million board feet per year)	585	534	525
Reduction in sustainable harvest level (million board feet per year)		51	60

Scribner board feet units. A timber sale volume is a sample estimate of the removable lumber in a stand just prior to sale. A forest inventory is a sample estimate of the total biomass in the forest stand from periodic inventory events. The two sample estimates, timber sales and forest inventory, use different field measurement standards and techniques to collect the data and derive a volume estimate. The DNR's forest inventory provides a far more extensive and detailed database of stand conditions across the entire forestland base and is therefore used for modeling. Timber sale samples exist only for a small proportion

of the land base, stands that have been harvested or will shortly be harvested. Therefore, because DNR's modeling process is based on forest inventory volumes, these inventory volumes need to be converted to estimate timber sale volume.

In addition, uncertainty about a modeled saleable volume is heightened when "unexpected" outcomes are produced. Unexpected outcomes are, in part, the result of expectations of the future being based on past experience. Future timber sales volumes and harvest practices are expected to be similar to the past. As the Preferred Alternative implements innovative harvest systems (for example, variable density thinning, riparian restoration harvest), of which there are few current examples, future actual sale timber volumes per acre may be different from the past. From the simple model illustrated above, a relatively small change between 35 thousand board feet per acre and 32 thousand board feet per acre illustrates differences between modeled yields and sold advertised timber sales. The relatively small change in yield has the potential to change the overall sustainable harvest level substantially, as noted in the example. For the Preferred Alternative, the greatest area of uncertainty in saleable yields is probably associated with riparian restoration harvests and harvest associated with biodiversity pathways. This uncertainty is a result of lack of historical experience and data.

2.3.2.2 Uncertainty in Available Area for Timber Harvesting

The most obvious uncertainty that exists with available harvest areas lies in the differences between Geographic Information System data and what actually exists on the ground, such as the degree of potential slope instability. Other less obvious uncertainties exist when changes are made to the land base as a result of a future policy or management decision, such as the development of a long-term conservation strategy for marbled murrelets, a strategy for the Southwest Washington owl circles, and the development of other local management strategies to address recreational or visual concerns. It is difficult to quantify all of these uncertainties; however, using the simple harvest model above, one can see that to significantly affect the sustainable harvest level, the change in the available area has to be quite substantial, on the order of several thousands of acres.

2.3.2.3 Uncertainty in Modeling Stand Development

There is uncertainty in modeling stand development because the modeling approaches are new. Forest management objectives of habitat conservation require knowledge of forest stand development processes, i.e. how a forest stand develops from one stage to another under natural and managed pathways. However, even for natural forest stands, the stand development processes for the development of structurally complex stands have only recently been understood and described for some forests in the Pacific Northwest (for example Franklin et al. 2002). As for managed stands, there are little empirical data about how managed stands will develop over long rotations as a result of various silvicultural treatments.

The stand development modeling presented in the Draft EIS was the first attempt by DNR to model stand structural development stages to support policy analysis. The approach used stand structural and treatment variables such as tree size and density in combination with thinning treatments. Presenting the results and getting feedback from the public, interested parties, and the technical review committee was a valuable learning experience. With these inputs, DNR reviewed and revised the approach to incorporate the development of multiple canopies as a principal determinate of stand development. The results presented in this Final EIS as compared to those in the Draft EIS are different. While DNR believes the Final EIS modeling approach is an improved modeling process, there will undoubtedly be future improvements. A systematic ground-truthing of the modeling approach and outputs has yet to be undertaken. This ground-truthing will provide important information to improve the modeling process.

2.3.2.4 Risk of Modeling Uncertainties

Forest management models provide a useful way to generate information that compares Alternative management strategies for decision-making. For complex and interrelated problems, such as policy development related to the management of forests, models provide a tool by which decision-makers can explore and discover their choices. Models do not supply definitive answers; rather, they provide information useful for developing policy and implementation plans.

Models have a number of uncertainties, often because of the necessity of simplifying reality. Uncertainties are managed in the modeling process by making assumptions. Modeling assumptions are developed in keeping with the level of risk associated with a modeling output. For example, if saleable volume was only of casual interest to the decision-makers, then the associated risk of modeling sale volume could be considered low. When the risk is low, it may be only important to discern the relative differences between Alternatives rather than more precise tangible differences. When the information is important to decision-makers, the level of risk is higher and more attention is paid to the associated assumptions related to the outputs. However, while more development about the assumptions may occur, the primary purpose of the model is still exploration and discovery of management options.

2.4 DEVELOPMENT OF FOREST MANAGEMENT ALTERNATIVES

Alternatives are one of the basic building blocks of an Environmental Impact Statement (EIS). They present meaningful options to decision-makers. Policy changes being considered by the Board of Natural Resources (Board) determine the characteristics of the Preferred Alternative being reviewed in this document. The Board sets policy direction, while DNR implements those policies through a series of internal procedures and implementation strategies.

Chapter 2

The six forest management Alternatives in the Final Environmental Impact Statement represent the range of choices considered by the Board of Natural Resources. The Preferred Alternative represents the Board's policy preference for how the forested trust lands are to be managed.

Design of the six Alternatives was based on information collected from the public during the scoping period, discussions with the Board, and discussions with a Technical Review Committee (see Appendix B for list of members). Information was also used from the preliminary models and associated results presented to the public (July 2002) and the Board (August 2002).

One objective of the Alternatives is to provide analysis and information about the results from potential policy and procedural changes. The Alternatives were designed to meet the purpose and need statement, facilitate the analyses, reflect public comment from the scoping process, and focus on Board interests.

The final set of six Alternatives reflect current management (Alternative 1), the 1997 Habitat Conservation Plan intent (Alternative 2), and four additional Alternatives that meet the Board's purpose. The intent of the six Alternatives is to examine a broad range of policy expectations that demonstrate passive, active, and innovative approaches to forest management.

The Alternatives and the information from the Environmental Impact Statement, along with separate financial and social analyses and public comment, provide key information for decision-making.

Policy changes will be implemented through the Board's adoption of a Preferred Alternative. Concurrently, with the Board's adoption of an Alternative, DNR's procedures and tasks will be adjusted to reflect the choices made in the approved Final EIS Preferred Alternative.

The Board will make a final decision regarding the Preferred Alternative and sustainable harvest level based on the following:

- Public comments on the Draft Environmental Impact Statement;
- Public comments offered at regular monthly Board meetings;
- Public comments on the selection of a Preferred Alternative;
- Additional analyses provided by DNR staff at Board request; and
- Final Environmental Impact Statement.

2.4.1 The Process for Defining the Preferred Alternative

The Preferred Alternative represents a series of choices in both policy and procedures. It incorporates information gathered and issues raised through the Draft EIS comment period, public meetings, comments at Board meetings, forest modeling, and Board discussion.

2.4.1.1 Board Deliberations to Select a Preferred Alternative

Public Comments

There are three primary ways the Board received public input: 1) from direct testimony to the Board, 2) from written material submitted directly to the Board, and 3) from the Draft EIS comments. The Board typically hears public testimony on subjects of interest to the public at every monthly Board meeting. As the Draft EIS was being developed and subsequent to its publication, the Board heard testimony at its regular monthly meetings from citizens, interest groups, and professionals regarding the development of a Preferred Alternative.

After the Draft EIS was released on November 10, 2003, seven public meetings were held in Lacey, Port Angeles, Mt. Vernon, Vancouver, Aberdeen, Spokane, and Des Moines. More than 350 people attended these meetings, and 146 commented. The public comments were taped and subsequently transcribed. Comments from these meetings, and comments received by mail and e-mail, were summarized and given to the Board at their January 2004 meeting. The Board also received the entire text of all the comments. The comments received during the Draft EIS comment period came from more than 740 groups and individuals, and included more than 4,500 individual comment statements. These comments were summarized into more than 100 categories. In general, comments encompassed the themes of trust income, environmental protection, and social benefits (see Response to Comments Summary in Appendix G).

Staff Reports

The Board requested a number of staff reports to aid their discussions of the various policy choices that are imbedded in the Preferred Alternative. The analyses were designed to address the Board's main questions:

- How do we conserve, enhance, and restore ecosystem habitats on landscape levels to meet Endangered Species Act requirements?
- How do we conserve, enhance, and create healthy working forests to meet the economic obligations to present and future trust beneficiaries?

The Board also wanted to understand the social dimensions of their decision. Several studies were presented to the Board before the Draft EIS was released.

- DNR undertook comprehensive public opinion research to understand the public's feelings and values about stewardship on state forested trust lands. DNR conducted focus groups during the spring of 2002 in three western Washington communities. The goal was to understand Washington residents' values related to forestry. The *2002 Sustainable Harvest Public Opinion Research: Washington's Vision for Forest Management* was presented to the Board on July 19, 2002.

- DNR also commissioned a statewide public opinion poll using the same questions as the public opinion research in order to provide statistically significant data to supplement the qualitative data provided in focus groups. The results of both the focus groups and the statewide survey were combined with input received at the town meetings held during the scoping process into a presentation delivered to the Board on July 19, 2002.
- In an effort to measure the impact on communities of timber harvests on forested trust lands across the state, the Board also received a report on "Socioeconomic Resiliency," which provides an indication of how reduction or increase in timber harvest will affect counties across the state. That report was presented to the Board on October 7, 2003 (Daniels 2004).

In December 2003, the Board further reviewed the social dimension of their decisions by asking for additional discussion of the size and nature of the rural-urban interface. At the January 8, 2004 Board meeting, reference material was presented that analyzed the extent of the rural-urban interface and possible issues in those areas. The Board then discussed implications of various policy positions for both rural and urban areas.

The economic and ecological outcomes of the policy choices before the Board were discussed in the Draft EIS. The Board discussed those results and asked for additional analysis based on comments from the public and their own discussions. The Board requested several additional model runs to understand the policy impacts of various approaches. The model runs examined the impacts of various combinations and variations for flow control, maturity criteria, ownership groups, intensive silviculture, and biodiversity pathways. These model runs were presented to the Board at meetings through January, February, and March of 2004. The Board also requested additional information about riparian areas, older forests, and social impacts of various policy options, especially in the rural-urban interface areas. They requested additional financial analysis and a closer examination of implementation costs under various policy options.

Concurrently and on an ongoing basis, DNR worked with the Technical Review Committee (see Appendix B), seeking its help to independently evaluate core assumptions used within the computer simulations.

2.4.1.2 Board-Generated Criteria

After the release of the Draft EIS, the Board defined their decision criteria and created a decision matrix as an aid to the discussion. To create this matrix, the Board had to identify key results they wanted, and then decide which policy decisions had a critical influence on the key outcomes. DNR staff helped the Board complete the matrix by using computer runs and reports to fill in the needed information. The information was qualitative, not quantitative, and was developed over time in collaboration between DNR staff and the Board (see Appendix F).

The key policy areas discussed by the Board included:

- Prioritizing Harvest by Volume or Value – Timber harvests are to be measured by volume; however, discussions focused on how forest stands should be selected for harvest to generate revenue. Discussions considered either prioritizing by standing volume or by economic criteria.
- Silviculture – Silviculture is a term that can be defined as the art and science of growing trees and managing a forest for a particular purpose. This discussion involved deciding to use one approach or a combination of forest management approaches, each of which produce different outcomes. The choices ranged from more active techniques, like thinning and fertilization, to less active, using longer rotations and less management. Within that range is a newer concept called biodiversity pathways, which is an innovative, active approach with the intent of restoring and creating both habitat and income.
- Timber Harvest Flow Constraints – Discussions involved how much to allow the sustainable harvest level to vary from decade to decade.
- Ownership Groups (sustainable harvest units)– The Board considered how various forested trust lands ownerships should be combined or separated for the purposes of calculating distinct sustainable harvest levels.
- On-Base Land – The Board discussed how much land is available for timber harvesting and forest management activities.
- Older Forests – This discussion reflected the Board's concern about how to treat older forests.
- Riparian Areas – The Board discussed the modeling assumptions being made about the management in riparian areas that would be consistent with the federal approved procedures based on the Habitat Conservation Plan.

After conducting sensitivity and other types of analyses, some results of choosing among the various policy issues appeared more significant than others. Key factors ultimately included: 1) revenue, 2) variability of revenue, 3) structurally complex forest development, 4) implementation costs and timing, and 5) long-term standing inventory. These items were discussed in a number of Board meetings.

2.4.1.3 Choosing a Preferred Alternative

The Board refined their key outcomes and developed policy direction and principles to direct the development of a Preferred Alternative. The policy direction was titled *Sustainable Harvest Calculation Management Principles and Objectives* (Principles and Objectives), and was ultimately attached to Board Resolution 1110 that described the Preferred Alternative. The Principles and Objectives included two significant core outcomes that would ultimately be incorporated into the Preferred Alternative:

1. Active management on an enlarged on-base landscape and
2. Broader economic, conservation, and other public benefits consistent with fiduciary responsibilities.

On February 3, 2004, DNR staff used the Board's direction contained in its Principles and Objectives, and the Board's discussion of the decision matrix, to create the Preferred Alternative. This Alternative appeared to meet the Board's policy criteria. The Board agreed on most of the policy choices in the Preferred Alternative, but requested more discussion about sustainable harvest units (ownership groups) and older forests.

Implementation considerations were discussed and economic analysis of the potential Preferred Alternative was presented on February 17, 2004. After further deliberation, the draft Preferred Alternative was agreed upon, and the Board directed DNR to prepare further analysis of the Preferred Alternative. This analysis was presented at the March 2, 2004 Board meeting. DNR discussed how the Preferred Alternative met the Board's two core outcomes.

The Board voted unanimously on the components of the Preferred Alternative and incorporated its elements in Resolution 1110. This resolution directs DNR to prepare a Final EIS that includes the Preferred Alternative and incorporates by reference the Principles and Objectives.

2.4.1.4 Draft EIS Alternative 6 Formed the Basis for the Preferred Alternative

The development of the Preferred Alternative by the Board of Natural Resources was largely based on the policies and procedures of Alternative 6 as analyzed in the Draft EIS. The policy objectives of the Draft EIS Alternative 6 and the Preferred Alternative are similar (see Appendix B, Section B.2.4), with the notable difference between the two Alternatives being the riparian management modeling assumptions.

As was noted in the Draft EIS, the riparian modeling assumptions of Alternative 6 did not clearly match the stated policy objectives, resulting in high levels of low-volume thinnings. The high levels of repeated-entry thinning activities raised numerous technical and policy questions by the Board, the Federal Services, and other key stakeholders, such as the Washington State Department of Fish and Wildlife.

In response to public comments and based on the Board's direction during the development of the Preferred Alternative, modeling assumptions were updated to reflect the Board's interest in implementing a biodiversity pathways approach across as much of the land base as possible, and implementing a more moderate level of riparian restoration activities. These considerations resulted in the evolution of the Draft EIS Alternative 6 into the Preferred Alternative in this Final EIS.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Under the State Environmental Policy Act, a "reasonable Alternative" is a feasible Alternative that meets the proposal's purpose and need statement at a low environmental cost (Washington Administrative Code 197-11-786). The following Alternatives were considered but not included in the detailed analysis because they did not meet the purpose and need and were therefore not determined to be "reasonable."

2.5.1 The "Un-Zoned Forest" Alternative

In the process of developing the six Draft EIS Alternatives (see Section 2.6), a seventh was developed, known as the "Biodiversity Pathways with Un-Zoned Management." An un-zoned management concept is one in which there are no special areas or zones set aside exclusively for either conservation benefits or commodity production. An un-zoned forest concept combines active forest management at the landscape and forest stand level for attaining conservation benefits and revenue goals. The goal of this Alternative was to examine an un-zoned management approach for all western Washington forested state trust lands following the principles of DNR's Habitat Conservation Plan approach for the Olympic Experimental State Forest.

Upon further analysis the un-zoned forest Alternative was rejected as a reasonable Alternative because it did not meet the requirements of the current Habitat Conservation Plan. Such an approach would likely require a major amendment to the plan (see Implementation Agreement, Habitat Conservation Plan, DNR 1997). Meeting the requirements of the Habitat Conservation Plan was one of the criteria for selecting a reasonable Alternative, along with meeting the trust mandate and federal and state laws.

2.5.2 Other Alternatives, Comments, and Suggestions

A very limited number of other Alternatives and a large number of suggestions were received from the public. DNR examined the details and included many elements of them in the six Alternatives presented in the Draft EIS. Components not included in the six Draft EIS Alternatives did not meet the purpose and needs statement (Appendix A).

2.6 FEIS ALTERNATIVES CONSIDERED IN DETAIL

Each of the Alternatives is a set of proposed policies and procedures, each of which represents a different way of achieving DNR's legal mandates and goals. As with any extensive activities on a landscape, implementation of any of the Final EIS Alternatives across western Washington could have environmental impacts. Potential impacts are evaluated in this document. In order to understand the range of possible impacts, the Alternatives are best understood in terms of their differences.

In this section, Final EIS Alternatives, including the Preferred Alternative, are described in terms of the:

- Common features shared by each Alternative; and
- Main policy, procedure, and implementation strategy choices that meaningfully distinguish each Alternative from the others.

2.6.1 Features Common to all Reasonable Final EIS Alternatives

Alternative 1 and each of the reasonable Final EIS Alternatives have the following common features:

- Comply with all state and federal laws;
- Meet DNR's trust mandates (the state's fiduciary duties as a trustee); and
- Fulfill DNR's 1997 Habitat Conservation Plan.

Each of the Alternatives is consistent with the Forest Resource Plan and DNR procedures, tasks, and guidelines, except where otherwise noted in the following Alternative descriptions.

In cases where Forest Resource Plan amendments are proposed, selection of that Alternative by the Board would result in Board-adopted amendments to the Forest Resource Plan.

Six Alternatives are analyzed in detail in this Final Environmental Impact Statement. If approved by the Board, Alternatives 2 through 5 and the Preferred Alternative would expressly change current policies to align with those included in the Environmental Impact Statement. Concurrent with the Board's adoption of a set of new policies and a new sustainable harvest level, DNR's procedures and implementation strategies would be adjusted to reflect the final policy choices.

2.6.1.1 The Olympic Experimental State Forest

The Olympic Experimental State Forest has specific management objectives and strategies in the Habitat Conservation Plan (HCP) that distinguish it from the other HCP Planning Units. The goal of the Olympic Experimental State Forest is to learn how to integrate timber production and conservation across the landscape, known as an "un-zoned" approach. The Olympic Experimental State Forest is treated in each of the Alternatives as an un-zoned forest, as specified by the Habitat Conservation Plan (page IV.81).

A few procedures that affect the Olympic Experimental State Forest vary among the Alternatives. Differences include the level of harvest deferrals, such as site-specific management direction for marbled murrelets, northern spotted owls, and other resources (see Appendix B, Deferrals Among Alternatives). In addition, some aspects of the Alternatives, when coupled with the unique management in the Olympic Experimental State Forest, would result in different impacts than anticipated in the other five westside HCP Planning Units. These differences are described, by resource, in the environmental effects sections of Chapter 4.

2.6.1.2 Policies and Procedures Common to All Alternatives

A small proportion of the policies, procedures, and implementation strategies vary among the reasonable Alternatives and those are detailed in the following subsections. All other policies, procedures, and strategies remain constant for each Alternative. Refer to Appendix C for a discussion of select resource areas evaluated in this environmental analysis that did not vary among the Alternatives.

2.6.2 Alternatives

The following subsections describe each Final EIS Alternative.

2.6.2.1 Alternative 1 – No Action (Current Operations)

Alternative 1 represents the Board of Natural Resources' existing policies and DNR's forest management strategies as indicated by the DNR Forest Resource Plan, 1997 Habitat Conservation Plan, departmental procedures and tasks, current DNR operations, and all current federal and state statutes. This Alternative represents an estimate of continued management of western Washington forested state trust lands with current management strategies. In this Alternative, projecting the status quo into the future represents uncertainties, such as how DNR would manage riparian areas or marbled murrelet habitat. Therefore, in the case of riparian areas and marbled murrelet habitat, current strategies of deferral are projected indefinitely.

2.6.2.2 Alternative 2 – Habitat Conservation Plan Intent

Alternative 2 represents existing Board of Natural Resources-approved policies and forest management strategies as defined by the DNR Forest Resource Plan, 1997 Habitat Conservation Plan, and current federal and state statutes. It does not include those current departmental procedures and tasks that were not approved by the Board. Management under this Alternative implements the Habitat Conservation Plan as originally negotiated with the Federal Services in 1997.

2.6.2.3 Alternative 3 – Combined Ownerships

Alternative 3 represents existing Board-approved policies (except Policy No. 6 on Trust Ownership Groups), forest management strategies defined in the DNR Forest Resource Plan, the 1997 Habitat Conservation Plan, and current federal and state statutes. "Combined Ownerships" refers to a change in Forest Resource Plan Policy No. 6 defining how to group the trusts' lands when applying the even-flow requirement in Policy No. 4.

2.6.2.4 Alternative 4 – Passive Management Approach

Alternative 4 represents managing western Washington forested state trust lands with passive management approaches to provide increased conservation and habitat protection while producing revenue. This approach maintains the 1997 Habitat Conservation Plan objectives, the DNR Forest Resource Plan, and current federal and state statutes. "Passive management" refers to a land management approach that allows forest growth and structural development processes to occur with little silvicultural (cultivation of forest species and stand care) activity.

2.6.2.5 Alternative 5 – Intensive Management Approach

Alternative 5 represents managing forested trust lands in western Washington with emphasis on revenue production on lands that are not dedicated to habitat conservation. It maintains 1997 Habitat Conservation Plan objectives and strategies, adheres to the DNR Forest Resource Plan (with exception of proposed changes), and meets current federal and state statutes. "Intensive or active management" refers to a land management approach that accelerates forest growth and structural development processes through greater use of silvicultural activities.

2.6.2.6 Preferred Alternative – Innovative Silvicultural Management

The Preferred Alternative represents managing forested trust lands in western Washington using innovative silvicultural management techniques, including biodiversity thinnings, to generate both increased conservation benefits and revenue for the trusts. Less intensive management of the riparian zones is a key distinction between this and Alternative 6 analyzed in the Draft EIS. This approach attempts to integrate habitat and revenue generation objectives while maintaining the current Habitat Conservation Plan approach and DNR Forest Resource Plan objectives, and meeting current federal and state statutes. Central to active management is placing more land in an on-base status with increased silvicultural activity. Many of these activities are designed to accelerate forest growth and structural development processes. The Preferred Alternative is expected to produce more complex stands than the other Alternatives.

2.6.3 Features that Vary Among Reasonable Alternatives

The six Alternatives feature changes to policies, procedures, and implementation strategies, which are summarized below.

2.6.3.1 Sustainable Harvest Units – Ownership Groups

Currently, the sustainable harvest calculation is based on sustainable harvest units or "ownership groups." The term "ownership groups" is used in the Forest Resource Plan to describe the grouping of different forested trust lands together for the purpose of calculating a discrete sustainable harvest level. Ownership groups include the state forested trust (also known as Forest Board Transfer) lands [individual counties (17 total in western Washington)], federal grant lands, and state forest non-trust (also known as Forest Board Purchase) lands (by DNR administrative regions, of which there are five in western Washington), Capitol State Forest, and Olympic Experimental State Forest (see Map 3 in Appendix). Current policy on ownership groups is defined in the DNR Forest Resource Plan under Policy No. 6 (Western Washington Ownership Groups). In all, there are 24 ownership groups. This current organization is retained in Alternatives 1 (No Action), 2, and 4.

Two variations of current policy are proposed in Alternatives 3, 5, and the Preferred Alternative. In Alternative 3, all western Washington forested state trust lands are placed into one ownership group. In Alternative 5 and the Preferred Alternative, the federal grant lands and state forest non-trust lands (currently five ownership groups) are placed into one ownership group. This reduces the overall number of groups from the current 24 to 20. The

change to ownership groups proposed in Alternatives 3, 5, and Preferred Alternative would require a change to Forest Resource Plan Policy No. 6.

2.6.3.2 Timber Harvest Levels

The method of calculating the sustainable harvest levels is central to the management of forested trust lands. The sustainable harvest level is defined in volumetric terms in the statues (Revised Code of Washington 79-10-300(s)) and, regardless of how it is calculated, the Board will adopted a sustainable harvest level in volumetric units. However, the sustainable harvest level can be calculated by several means, including volume, acreage, and economic value. Current Board of Natural Resources policy uses timber volume.

When the sustainable harvest is calculated by volume, as current policy dictates (Forest Resource Plan Policy No. 5), the objective is to determine the maximum harvest volume that can be sustained over a planning period, subject to a large number of legal and policy constraints. Timber volume is expressed in terms of millions of board feet of timber.

If economic value is used to replace volume, the objective is to maximize the revenue value of the harvest, subject to other policy goals and constraints. This is significantly different from a volume model approach because the selection of stands for harvest in an economic model is likely to be more responsive to market demands and operational costs. The net effect may not be a difference in harvest level, but a difference in revenue generated.

Alternatives 1 through 4 incorporate current policy, calculating the harvest level by volume. Alternative 5 and the Preferred Alternative calculate the harvest level using an economic value approach and require a change to Forest Resource Plan Policy No. 5.

2.6.3.3 Sustainable Even-Flow Timber Harvest

"Even-Flow" Timber harvest ensures that about the same amount of timber is available now and for future generations in perpetuity. Basically, "sustained yield" means that harvest (yield) does not exceed productivity (growth). Theoretically it is a method for reaching forest equilibrium over time. However, changes in forest practices regulations, management objectives, land classifications (zoning), listing of threatened and endangered species, variable market conditions, and other factors can alter the equilibrium. This necessitates periodic adjustments in the calculation.

The current policy for sustainable even-flow timber harvest is defined in Forest Resource Plan Policy No. 4. The policy states, "The Department will manage state [trust] forest lands to produce a sustainable, even flow harvest of timber, subject to economic, environmental and regulatory considerations." In application, the term "even flow" means that roughly the same amount of timber is offered for sale by DNR on an ongoing basis. It refers to the amount of variability from the sustainable harvest level that will be entered into the computer model. Different interpretations of sustainable even flow would result in different harvest levels.

The definition for sustained yield contained in the Revised Code of Washington (RCW 79.10.310) requires "management of the forest to provide harvesting on a continuing basis without major prolonged curtailment or cessation of harvest." This concept of sustained or

sustainable even flow can be characterized in several ways. Alternative 1 (No Action) and the five other Alternatives explore different approaches to what is an "appropriate" level of variability by approaching even flow in different ways.

Alternatives 1 and 4 propose no change to the current implementation of Forest Resource Plan Policy No. 4. As such, even flow is managed as a narrow band of variation, allowing the decadal harvest level to vary by as much as 25 percent above and below the long-term harvest level.

Alternative 2 proposes a non-declining even-flow approach, similar to the 1996 DNR sustainable harvest calculation.

Alternative 3 expands the allowable variation in harvest level, controlling the harvest fluctuation level within a wider band with no prolonged curtailment or cessation of harvest (RCW 79.10.310).

Alternative 5 and the Preferred Alternative propose to implement the sustainable timber harvest even-flow policy by not varying the subsequent decadal harvest from a previous decade by more than plus or minus 25 percent. This approach is similar to the flow constraint approach used by Bare et al. in their 1997 analysis and modeling the DNR Habitat Conservation Plan.

Alternatives 2 ,3 ,4, 5, and the Preferred Alternative would require revisions to DNR Procedure 14-001-010 (Determining Harvest Levels and Completing the Five-Year Action and Development Plan) and Forestry Handbook Task 14-001-020 (Developing the Draft Five-Year Action and Development Plan).

2.6.3.4 Silviculture

Silviculture is the art and science of cultivating forests to achieve objectives. DNR uses a site-by-site approach for evaluating and implementing silvicultural treatments, based on site-specific, rotational or long-term efficiency analysis return on investment, variable biological conditions, and social and physical limitations. Site-specific silvicultural prescriptions include activities such as: site preparation, planting specific tree species at specified densities, fertilization, weeding of non-desirable species, and the harvesting of trees.

Cutting of trees is prescribed to achieve objectives, i.e., revenue generation and/or restoration of structurally complex forests. Not all cut trees are harvested, i.e., removed from the stand. For example, young, dense, naturally regenerated western hemlock forest stands are often thinned to reduce the number of trees so that the residual trees can develop into larger trees. This type of thinning is called pre-commercial thinning.

Commercial thinning removes a portion of a stand, leaving a substantial number of trees to remain after a timber harvest. Commercial thinnings are typically carried out with the multiple objectives of generating revenue and accelerating the forest stand's development.

DNR typically implements commercial thinnings in stands when they are in the competitive exclusion stage of stand development (see Appendix B for a description of stand development stages). Trees in the competitive exclusion stage compete for direct

sunlight, nutrients, water, and space. These stands are nearing, or have exceeded, full site occupancy and have little diversity in tree sizes. Traditional commercial forestry thinning "captures" the natural tree mortality before it occurs by harvesting the smaller trees that would normally die without harvest. Normally, commercial thinning in these competitive exclusion stands is from below, i.e., the thinning treatment removes the smallest trees first. Thinning usually results in about 70 percent of the initial stand remaining after harvest, measured as basal area. The traditional thinning treatment typically does not affect the stand's most dominant trees and the treatment perpetuates the competitive exclusion stage, with perhaps a brief interlude of understory development after the thinning harvest (see Photograph 1). The diversity of tree sizes of the dominant trees remains much the same as prior to the thinning treatment, but the stand's optimal growth rate is sustained.

For a forest stand to develop into a more structurally complex forest stage (Photograph 2), it must have vertical and horizontal diversity of tree sizes (in terms of tree heights and diameters) and tree spacing; large standing dead trees (snags); and large down logs (down woody debris). To develop such structural characteristics, a stand needs to develop along additional pathways than the single one described in the preceding paragraph. Stands in a competitive exclusion stage need to transition into an understory development stage to establish tree species under the main tree canopy so that these smaller trees can grow and develop into the mid-story. This development will, in time, provide the vertical and horizontal diversity of tree sizes. The remaining overstory trees will continue to develop and grow larger until they can be recruited either naturally (through disease or natural death for snags and through blowdown for large woody debris) or artificially through management to provide large standing dead trees or down woody debris.

To manage a stand along such a development pathway requires forest managers to have a comprehensive understanding of the structures and developmental processes in forest stands (Franklin 2002; Carey 2003). Carey et al. (1996) coined the phased "biodiversity pathways" for the management of forest stands (and forested landscapes) to achieve objectives of conserving biodiversity and generating revenue through the application silviculture that "accelerates" the development of structurally complex stands

Photograph 1. A thinned 60-year-old Douglas-fir stand on average site (III) in competitive exclusion.

Photograph 2. A Sitka spruce, Western hemlock, Douglas-fir stand on average site in a structurally complex stage with active management. It is estimated that similar structures could be obtained in 60 to 80 years.

The principal silvicultural tool of biodiversity pathways is thinning forest stands in a way that encourages diverse development of the residual forest stand, i.e., a thinning treatment that will likely result in the development of vertical and horizontal diversity of tree sizes. This is achieved through techniques such as variable density thinning, where the stand is thinned to different residual tree densities. Heavy thinning treatments can typically result in less than 50 percent of the initial stand remaining after harvest. Also, some dominant trees are removed from the upper canopy to create sufficient space and gaps for the development of smaller trees (Carey et al. 1999). Without such thinning treatments in dense competitive exclusion stands, the density of dominant trees will not allow for the development of understory trees within the stand. Normally, these variable density thinning treatments, both heavy and light, harvest across the diameter classes. For these reasons, variable density thinning is not necessarily inferior economically to traditional thinning.

The objective of variable density thinning and other treatments that encourage structural development is to increase the diversity of the trees that represent the largest cohort of trees within a stand. Figure 2.6-1 provides a hypothetical comparison between a stand in competitive exclusion stage and a structurally complex stage. Note that the distribution of tree sizes is narrow for the competitive exclusion stand (also see Photograph 1), while the structural complex stand demonstrates more diversity in tree sizes and species (also see Photograph 2).

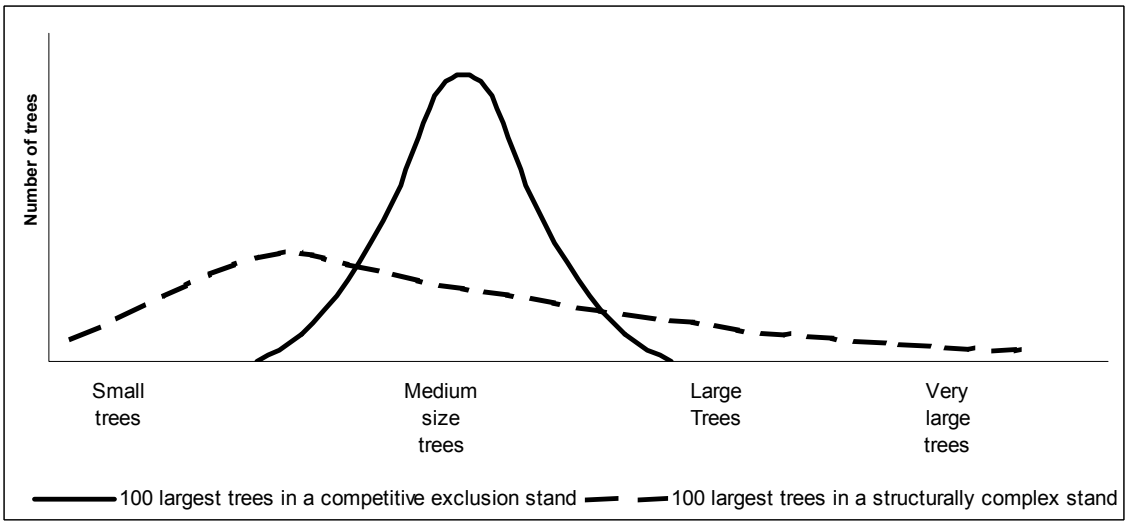

Figure 2.6-1. Hypothetical Example of the Distribution of Tree Sizes for the 100 Largest Trees in a Competitive Exclusion and Structurally Complex Stand

Typically, a regeneration harvest will occur at the time when landscape and stand objectives are met, i.e., revenue generation and/or structurally complex forest restoration. A regeneration harvest is the end-of-the-rotation treatment before the stand is re-planted or re-established through natural regeneration.

The principles of the biodiversity pathways approach to silvicultural treatment (based on Carey et al. 1996, page 23) are to:

1. Retain large-tree legacies (snags, large live trees, and their epiphytes) and conservation of soil organic matter, seed banks, and coarse woody debris and understory vegetation at harvest;
2. Minimize site preparation, but under-plant widely spaced, site-appropriate coniferous species to supplement natural regeneration of tree and shrub species;
3. Implement modified thinnings that retain patches and opens up the forest canopy to encourage the development of a diverse and patchy understory that mimics that in old forests; and
4. Directly improve habitat quality by creating cavity trees and adding coarse woody debris in the form of felled trees.

The principles call for a new silvicultural system that manages stand cohorts. The principles are applied over a rotational length silvicultural prescription. Depending upon a stand's current condition, site, and species composition, different combinations of treatments based on the principles above would be applied at different stages during the rotation to maintain the stand on a pathway towards developing a structurally complex forest stand. The pathway is geared to optimally meeting these stand objectives.

The harvest treatments in the biodiversity pathways approach would typically be variable density thinnings that use a mix of heavy and light thinning, and regeneration harvests. The variable density thinnings would likely include a mix of heavily thinned areas (e.g., where less than 50 percent of the initial stand remains after harvest), lightly thinned areas (e.g., where more than 50 percent of the initial stand remains), small openings (of approximately 0.25 to 10 acres in size depending upon the stand conditions and objectives), and un-thinned areas.

Selecting the type of treatment and intensiveness of the thinning would be determined by site-specific conditions and stand objectives. Analysis of current forest conditions, the riparian and wetlands areas, and designated habitat management areas suggests that only about 35 percent of this area (231,000 acres) is suitable for long (140-year) rotation silviculture with heavy thinnings. Suitability is defined here as conifer-dominated stands that are not in a densely overstocked state. Thinning large-diameter closed (*competitive exclusion*) stands too heavily could lead to blow-down that may damage much of the existing forest structure (e.g., snags). In addition to the harvest treatments, the silvicultural prescriptions would likely include treatments to create and maintain snags, coarse woody debris, and small openings.

Regeneration of stands within the biodiversity approach is determined by alternating maturity criteria. Forest stands with current conditions that can be managed with variable

density thinnings on long rotation may have maturity criteria of 110 to140 years depending upon the site, species ,and stand objectives. Forest stands that are currently overly stocked (i.e., have too many trees) and are beyond response to thinning without acceptance of undue risk are not conducive to longer rotations with variable density thinning. These stands have earlier maturity criteria, between 40 to 70 years depending upon site, species, and stand objectives. After their regeneration, these stands will be managed on a long rotation.

Silviculture in the Alternatives

Alternatives 1, 2, and 3 reflect traditional even-age silviculture that DNR practices currently. Planting densities are typically 300 to 400 trees per acre, but are tailored to site-specific conditions, species, and stand objective needs. Vegetation management and pre-commercial thinning are applied to stands, although economic objectives determine the intensity and frequency of these treatments. Fertilization and pruning techniques are limited. Commercial thinning harvests are normally from below and result in a residual (post harvest) stand that retains 70 percent of the initial pre-harvested stand. The minimum regeneration harvest age (the earliest age that a stand is considered eligible for regeneration harvest) is determined by balancing tree volume growth and economic potential, as well as site conditions, species, and stand objectives. For example, a Douglas-fir stand on site class III ground (average quality) has a maturity criterion modeled at 60 years. At regeneration harvest, a minimum of eight live trees per acre is left in the residual stand (7 percent of the original stand under Alternative 1).

Silviculture in Alternative 4 is very similar to Alternative 1, 2, and 3; however, the maturity criteria are lengthened. This has the effect of extending the rotation length of managed stands, whereby the stand may approach its culmination of growth (the end of the period of rapid growth). As an example, in Alternative 4, a Douglas-fir stand on site class III ground has a minimum regeneration harvest age of 80 years. At regeneration harvest, a minimum of eight live trees per acre is left in the residual stand.

In Alternative 5, the silviculture is more intensive. Planting densities are in the 300 to 400 tree per acre range with selected planting stock. Vegetation management and pre-commercial thinnings are applied and fertilization is used on selected sites. Stands are scheduled for regeneration harvest based on economic value and the maturity criteria are determined by the economic potential of stand growth. In this Alternative, the emphasis is on harvesting stands of trees when they have reached their maximum discounted economic value, expressed as net present value. As an example, in Alternative 5, a Douglas-fir stand on site class III ground has a minimum regeneration harvest age of 50 years. At regeneration harvest, a minimum of eight live trees per acre is left in the residual stand.

In the Preferred Alternative, the silviculture is a mix of current DNR silvicultural practices, more intensive silviculture and silvicultural approaches based on biodiversity pathways (Carey et al. 1996). For this Alternative, silviculture on Upland Areas with General Management Objectives (see Chapter 4, Section 4.2) reflects a mix of current DNR silvicultural practices (as in Alternative 1 through 3) and more intensive approaches (as in Alternative 5). Commercial cohorts of trees (these are a group of trees of similar characteristics, such as age or size that exist in a stand) are typically managed with even-

age silvicultural regimes. Planting densities typically range between 300 and 400 trees per acre, but may be more or less as determined by the optimal pathway to achieve the objectives. Stands are also treated for vegetation management and pre-commercial thinning as necessary. The maturity criteria are flexibly determined by the landscape and stands objectives. Economic value of the growth potential of the stand is an important consideration; however, other aspects and conditions such as social and environmental factors will play a role in determining the stand's regeneration age. At regeneration harvest, a minimum of 8 trees per acre is left in the residual stand.

For the Preferred Alternative, silviculture in Upland Areas with Specific Management Objectives and Riparian and Wetland Areas is a mixture of current DNR silviculture (as in Alternative 1 through 3) and silviculture based on biodiversity pathways principles. DNR silviculture is assumed to be applied to hardwood-dominated stands, while biodiversity pathways silviculture is applied to conifer-dominated stands.

Each Alternative would require changes to Forest Resource Plan Policy No. 4, and to DNR Procedure 14-005-020 (Identifying and Prioritizing Stands for Regeneration Harvest).

2.6.3.5 Northern Spotted Owl Habitat Management

None of the Alternatives proposes changes to the nesting, roosting, foraging, and dispersal habitat strategies outlined in the Habitat Conservation Plan (page IV.3). Northern spotted owl management is represented by a suite of policy, procedural, and implementation strategies. These are currently specified in the Habitat Conservation Plan and Procedure 14-004-120.

Northern spotted owl habitat circle management is currently applied to three types of owl circles listed in Procedure 14-004-120. As specified in the Implementation Agreement Memorandum # 1 of the Habitat Conservation Plan, no timber harvest is allowed within certain northern spotted owl circles prior to 2007, and harvest is allowed only within non-habitat areas of several other circles. These areas are identified as "Memorandum # 1" northern spotted owl circles.

Management in two other groups of northern spotted owl circles—"Status 1 – Reproductive" and "Southwest Washington"—is restricted by Procedure 14-004-120. Timber harvest activities are allowed only in the non-habitat portions of Southwest Washington northern spotted owl circles, and only habitat enhancement activities are allowed in the non-habitat portion of all Status 1 – Reproductive northern spotted owl circles throughout the planning area. The Washington Department of Fish and Wildlife defined both Status 1 – Reproductive and Southwest Washington northern spotted owl circles.

All Alternatives maintain the management of Memorandum # 1 northern spotted owl circles until 2007.

Management of Status 1 – Reproductive and Southwest Washington northern spotted owl circles outside the Olympic Experimental State Forest varies among the Alternatives. Alternatives 3, 4, 5, and the Preferred Alternative propose to defer Status 1 – Reproductive northern spotted owl circles from harvest prior to 2007, while Alternative 2 proposes no

deferral of these circles. Final EIS Alternatives 3, 4, 5, and the Preferred Alternative protect the Southwest Washington northern spotted owl circles prior to 2006, while Alternative 2 proposes no deferral of these circles. In all Alternatives except Alternative 1, timber harvests in Status 1 – Reproductive northern spotted owl circles in the Olympic Experimental State Forest are not deferred. Adoption of any of the Alternatives other than Alternative1would require a change in Procedure 14-004-120, but no amendment to the Habitat Conservation Plan would be required.

Under current procedures, when the area designated for nesting, roosting, foraging, or dispersal management within a watershed (based on 2000 Watershed Administrative Unit delineations and referred to in this document as "watershed") is below 50 percent of the desired habitat threshold, regeneration harvests are not allowed. Regeneration harvests are allowed when the threshold is reached or exceeded (Habitat Conservation Plan, page IV.4). If less than 50 percent of designated nesting, roosting, foraging, or dispersal management areas in a watershed meets the habitat requirements, then only habitat enhancement activities may be conducted, even in the non-habitat portion of that watershed. Habitat enhancement includes thinnings that accelerate the development of structurally complex forest stands. This current management is modeled only in Alternative 1 (No Action), and would require no change to procedure.

In Alternatives 2, 3, 4, 5, and the Preferred Alternative, a target of 50 percent desirable habitat is established for designated nesting, roosting, foraging, or dispersal management areas within a watershed. In addition, regeneration harvests and thinnings are allowed in non-habitat areas in the rest of the watershed even if the watershed currently has less than 50 percent habitat.

The Preferred Alternative takes this strategy one step further to include silvicultural treatments based on concepts of biodiversity pathways described in Section 2.6.3.4 on Silviculture.

Alternatives 2, 3, 4, 5, and the Preferred Alternative would require a change to Procedure 14-004-120 (Management Activities Within Spotted Owl Nest Patches, Circles, Designated Nesting, Roosting, Foraging, and Dispersal Management Areas) and are consistent with the Habitat Conservation Plan.

2.6.3.6 Old Forest Components

The definition, components, extent, and management of "old forest" are important issues in sustainable forestry management. Old forests are defined as forest inventory units with old growth structure. DNR currently manages old forests with four basic guidelines, in addition to the northern spotted owl requirements discussed previously.

1. The Old Growth Research Area deferrals (Forest Resource Plan Policy No. 14) will be deferred from harvest. The purpose of these deferrals is to maintain DNR's ability to conduct research and collect data that may assist management elsewhere and benefit the trusts in the long run.
2. Olympic Experimental State Forest conservation strategies in the Habitat Conservation Plan specify that 20 percent of forested trust lands in any given Olympic Experimental State Forest landscape will be maintained in older forest conditions (Habitat Conservation Plan, page IV.88).
3. Where DNR manages at least 5 percent of the total watershed, DNR will maintain at least 50 percent of forested trust land in trees 25 years old or older (Task 14-001-010, Maintain Mature Forest Components). This "50/25" strategy stipulates that until 50 percent of a watershed meets the forest maturity criterion, no regeneration harvest is allowed in that watershed.
4. Legacy and reserve trees will be retained in regeneration harvest units as detailed in Procedure 14-006-090 [Legacy and Reserve Tree Levels for Regeneration Harvest Units (Variable Retention Harvesting)].

Alternative 1 includes all provisions for old forest management in current operations, as defined above, requiring no changes to policy or procedure.

The remaining Alternatives maintain two of the four basic components of current management—Old Growth Research Area deferrals as defined in Forest Resource Plan Policy No. 14, and the management for old forest conditions in the Olympic Experimental State Forest as defined in the Habitat Conservation Plan (page IV.88).

Alternatives 2, 3, 4, 5, and the Preferred Alternative do not maintain the "50/25" strategy and would require changes to Task 14-001-010 if one of these Alternatives is adopted by the Board. In addition, all Alternatives except Alternative 1 replace the required legacy and reserve tree level requirements in Procedure 14-006-090 with language implementing the protection of structurally unique trees and snags described in the Habitat Conservation Plan (pages IV.156-157). Under Alternatives 2, 3, 4, 5, and the Preferred Alternative, this legacy and reserve tree procedure would change from the current procedure requiring retention of 7 percent of the trees in regeneration harvest units to the Habitat Conservation Plan strategy of retaining a minimum of 8 trees per acre.

Alternatives 4, 5, and the Preferred Alternative have different approaches to maintaining and/or creating old forest conditions.

Alternative 4 proposes to defer for the entire planning period all current forest stands with an age equal to or greater than 150 years in the 2001 forest inventory.

Rather than specifically preserving all forests of a certain age existing today, Alternative 5 and the Preferred Alternative propose that 10 to 15 percent of each HCP Planning Unit be targeted as old forests, based on structural characteristics.

Adoption of these features by the Board would require changing Forest Resource Plan Policies to reflect this change in policy direction.

2.6.3.7 Riparian and Wetland Areas

The Riparian and Wetland Management Zone strategies in the Alternatives are based on the management objectives described in the Habitat Conservation Plan. The Board of Natural Resource and the DNR are not deliberating a decision with regard to riparian management as part of this sustainable harvest calculation. Parallel with this analysis, the DNR and the Federal Services are undertaking development of a riparian strategy. However, this riparian strategy has not been completed.

The analysis included within this sustainable harvest calculation, therefore, examines the effects of a reasonable set of estimates of future procedures that meet the Habitat Conservation Plan riparian management objectives. To aid in understanding DNR's Habitat Conservation Plan management of Riparian and Wetland Areas, some of the history of planning and implementation is provided below.

The Habitat Conservation Plan specified an interim set of management procedures to be used until permanent procedures could be developed by DNR, then reviewed and approved by the Federal Services (Habitat Conservation Plan, page IV.61). Once implementation began according to the plan, DNR agreed not to conduct activities in Riparian Management Zones—other than limited road development and maintenance—until a permanent procedure had been agreed upon. Current management of these sensitive areas follows the plan's guidelines and is identified in Procedure 14-004-150 (Identifying and Protecting Riparian and Wetland Management Zones in Westside Habitat Conservation Plan Planning Units, excluding the Olympic Experimental State Forest Planning Unit). As stated in the plan, Riparian Management Zones are to be developed on stream types 1, 2, 3, and 4, and Wetland Management Zones are to be developed for wetlands greater in size than 0.25 acre.

Currently, no harvest activities are conducted within designated Riparian Management Zones, except road and yarding corridor crossings. Activities are allowed within the Wetland Management Zones as identified in Procedure 14-004-110. These guidelines are assumed unchanged in Alternatives 1 and 4.

Alternatives 2, 3, 5, and the Preferred Alternative instead provide a range of restoration and silvicultural activities that may be considered under the final riparian procedure. Riparian ecosystem restoration encompasses a range of activities that must be site-specific and tailored to the physical and biological conditions at a particular site.

As defined in the Habitat Conservation Plan (page IV.62), disturbance of areas of potential slope instability, including those within Riparian and Wetland Areas, is restricted to light access development and maintenance (road and yarding corridors).

In Alternatives 2 and 3, restoration and silvicultural activities are assumed to occur at a moderate intensity, that is to say less than 1 percent per year of the total Riparian and Wetland Area may have a silvicultural treatment. Most of these treatments are assumed to be traditional thinnings (see Section 2.6.3.4) within the outer Riparian Management Zones. The outer zones are the minimal-harvest zone and the low-harvest zone (HCP page IV.70). These light thinnings normally retain at least 50 percent of a forest stand after thinning.

In Alternative 5, restoration and silvicultural activities are allowed at moderate intensity where less than 1 percent per year of the Riparian and Wetland Area may be treated with a restoration activity. Alternative 5 assumes similar thinning treatment to Alternatives 2 and 3.

The Preferred Alternative assumes that the restoration treatments in the outer Riparian Management Zones will be a combination of traditional thinnings, patch cuts of 0.5 to 2 acres, and biodiversity pathway approaches. Unlike the Draft EIS Alternative 6, where the restoration treatments could be characterized as extensive, the Preferred Alternative treats fewer acres per year: less than 1 percent per year of the total Riparian and Wetland Area. The change from the Draft EIS Alternative 6 to the Preferred Alternative was in response to the Board's direction and public comments.

The Habitat Conservation Plan management strategies for the Olympic Experimental State Forest are designed to effectively maintain key physical and biological functions until streams recover sufficiently from past disturbances. Combined with the current forest conditions and experimental objectives, the Olympic Experimental State Forest riparian strategies are different from the five Westside HCP Planning Units (page IV.132).

2.6.4 Projected Harvest Levels by Alternative

Each Alternative has two major components. The first is the set of policy and procedural changes (Table 2.6-1) necessary to accomplish the goals of that Alternative, and the second is the decadal sustainable harvest levels by ownership groups and trusts (Tables 2.6-2 and 2.6-3).

The modeling outputs for an Alternative provide substantial information to help understand the management impacts and harvest levels associated with each Alternative. The modeling outputs are based on reasonably available information, and are used in the Environmental Impact Statement to inform decision-makers and the public of possible significant impacts on various resources. These outputs, however, do not form the basis of the analyses in this document. Instead, the environmental analysis is based on a review of proposed changes to policy and procedures under which DNR operates. This is because DNR's actions under all Alternatives would be governed by policies and procedures, and would not simply follow the management pathways shown by modeling outputs. The analysis, therefore, takes into consideration the complete suite of policies, strategic plans, and procedures that direct and guide DNR's forest management activities on western Washington forested state trust lands. DNR considers the model outputs as the best information available to illustrate the range of likely outcomes for each of the Alternatives at the HCP Planning Unit scale. In Section 4.15, Cumulative Effects, modeling outputs and additional data are used to help describe the relative potential impacts at the watershed scale.

Table 2.6-1. Summary of Policy, Procedure, and Task Changes under the FEIS Alternatives

Management Issue	Policy, Procedure, Task Reference	Forest Management Alternatives					
		1	2	3	4	5	Preferred Alternative
Ownership groups	Policy No. 6	Current policy (24 groups)	Current policy (24 groups)	Change policy (1 group)	Current policy (24 groups)	Change policy (20 groups)	Change policy (20 groups)
Even-flow of harvest	Policy No. 4	Current policy	Update policy discussion	Update policy discussion	Current policy	Update policy discussion	Change policy
	PR 14-001-010 TK 14-001-020		Change procedure, task	Change procedure, task	Change procedure, task	Change procedure, task	Change procedure, task
Harvest regulation	Policy No. 5	Current policy	Current policy	Current policy	Current policy	Change policy	Change policy
Maturity criteria	Policies No. 4, 11, 30	Current policy and procedure	Update policy discussion (No. 4)	Update policy discussion (No. 4)	Update policy discussion (Nos. 4, 11)	Update policy discussion (Nos. 4, 11)	Change policy (Nos. 4, 11, 30)
	PR 14-005-020		Change procedure	Change procedure	Change procedure	Change procedure	Change procedure
Northern spotted owl conservation	Nesting, roosting, foraging, and dispersal PR 14-004-120	Current procedure	Change procedure	Change procedure	Change procedure	Change procedure	Change procedure
	Owl circles PR 14-004-120	Current procedure	Change procedure	Change procedure	Change procedure	Change procedure	Change procedure
Old forest components	Targeting Older Forest Conditions	Current policy	Current policy	Current policy	Update policy discussion	Change policy	Change policy
	Task 14-001-010 (Maintaining Mature Forest Components)	Current task	Change Task	Change Task	Change Task	Change Task	Change Task
	PR 14-006-090 (Legacy and Leave Tree Levels)	Current procedure	Change procedure	Change procedure	Change procedure	Change procedure	Change procedure

Table 2.6-2. Summary of State Trust Lands Sustainable Harvest Level in Million Board Feet per Year by Sustainable Harvest Unit (Ownership Group) for First Decade (2004-2013) Under Each Alternative

		Sustainable Forest Management Alternatives					
		1	2	3	4	5	PA
Trust Group	Ownership Group	First Decade Values in Millions of Board Feet per Year					
Federal Granted Trusts	DNR Central Region	42	66		62		
	DNR Northwest Region	44	56		48		
	DNR Olympic Region	7	17		14		
	DNR South Puget South Region	41	34		24		
	DNR Southwest Region	56	65		56		
	Federal Grants as one Westside group					260	307
	Capitol State Forest	39	42		39	41	37
	Olympic Experimental State Forest	18	63		10	136	77
State Forest Transfer Trust	Clallam County	7	15		17	23	20
	Clark County	12	13		10	13	10
	Cowlitz County	5	6		5	6	5
	Jefferson County	5	6		3	7	6
	King County	9	8		6	11	10
	Kitsap County	3	3		2	3	2
	Lewis County	15	21		18	22	18
	Mason County	8	9		7	9	5
	Pacific County	4	8		7	9	10
	Pierce County	4	4		1	5	7
	Skagit County	30	35		32	36	49
	Skamania County	5	14		3	15	21
	Snohomish County	23	28		27	27	27
	Thurston County	3	6		3	4	5
	Wahkiakum County	4	5		6	7	6
	Whatcom County	11	14		13	13	14
	All trusts as one Westside group			663			
	Westside harvest level	396	537	663	411	648	636

Note: Total harvest values in this table do not match all values in Table 2.6-3 due to rounding.

Table 2.6-3. Summary of Projected Harvest Levels in Millions of Board Feet Per Year for First Decade (2004-2013) by State Trust, by Alternative

Trusts	Sustainable Forest Management Alternatives					
	1	2	3	4	5	PA
	First Decade Values in Millions of Board Feet per Year					
Agricultural School	9	9	8	12	11	17
Capitol Grant	34	0	47	29	58	58
Charitable/Educational/Penal & Reformatory Institution	14	15	17	12	16	19
Common School and Indemnity	113	174	180	119	202	197
Community College Forest Reserve	1	0.9	0.3	1	0.5	1
Escheat	2	1.7	2	1	1	1
Normal School	6	12	11	7	13	9
Scientific School	23	22	28	23	27	32
State Forest Purchase	33	37	60	36	45	42
State Forest Transfer	159	212	299	167	260	248
University - Original	1	0.4	1	1	1	1
University - Transferred	1	12	9	3	13	12
Total	**396**	**537**	**663**	**411**	**648**	**636**

Note: Total harvest values in this table do not match all values in Table 2.6-2 due to rounding. A"zero" value in the table is where the estimated harvest level is less than 1 million board feet annually. A zero value **does not** denote that there is no harvest for the trust in that decade.

Tables 2.6-4 through 2.6-6 present a summary of the Alternatives' major policy and procedural changes, modeled harvest volumes by sustainable harvest unit (ownership group) and trust, off- and on-base acres, land class acreages, and average rotation lengths.

2.6.4.1 Summary of Rotation Lengths

The application of silviculture policy decisions on the forest interacts with other policy objectives such as sustainable timber harvest flow, sustainable harvest units, and habitat objectives. The interaction of these policy goals together in an Alternative can be expressed as an average rotation length. These are presented for the Alternatives in Table 2.6-6.

Table 2.6-4. Summary of Off- and On-Base Lands

Year	Alternative	Off-Base		On-Base: Riparian and Wetland Area		On-Base: Uplands with Specific Objectives		On-Base: Uplands with General Objectives	
		Acres	%	Acres	%	Acres	%	Acres	%
2004	Alt.1	763,000	55%		0%	322,500	23%	305,200	22%
	Alt.2	489,300	35%	214,800	15%	343,100	25%	343,500	25%
	Alt.3	514,400	37%	238,600	17%	328,100	24%	309,600	22%
	Alt.4	755,500	54%		0%	326,400	23%	308,800	22%
	Alt.5	513,400	37%	238,700	17%	329,600	24%	309,000	22%
	PA	515,500	37%	237,800	17%	327,800	24%	309,600	22%
2013	Alt.1	736,600	53%		0%	348,400	25%	305,700	22%
	Alt.2	281,100	20%	278,100	20%	477,200	34%	354,200	25%
	Alt.3	213,000	15%	346,200	25%	477,200	34%	354,200	25%
	Alt.4	573,400	41%		0%	463,500	33%	353,800	25%
	Alt.5	213,000	15%	346,200	25%	477,200	34%	354,200	25%
	PA	232,100	17%	329,000	24%	475,400	34%	354,200	25%

Notes:
Off-base acres include both long-term (multiple decade) timber harvest deferrals (such as northern spotted owl nest patches, Natural Area Preserves) and short-term deferrals (such as some transition lands, northern spotted owl circles in some Alternatives).
PA = Preferred Alternative

Table 2.6-5. Approximate Land Class Areas by HCP Planning Unit

HCP Planning Unit	Riparian and Wetland Areas		Uplands with Specific Objectives		Uplands with General Objectives		Total
	Acres	%	Acres	%	Acres	%	Acres
Columbia	86,400	32%	99,500	37%	81,600	31%	**267,500**
N. Puget	92,700	24%	205,000	54%	83,800	22%	**381,500**
OESF	111,300	43%	145,200	57%			**256,500**
S. Coast	81,000	35%	36,700	16%	115,300	49%	**233,000**
S. Puget	34,600	24%	82,100	58%	25,200	18%	**141,900**
Straits	20,700	19%	32,900	30%	56,800	51%	**110,400**
Total	**426,700**	**31%**	**601,300**	**43%**	**362,700**	**26%**	**1,390,700**

OESF = Olympic Experimental State Forest

Table 2.6-6. Average Rotation length (in years) by Alternative

	Alternatives					
Decades	**Alt.1**	**Alt.2**	**Alt.3**	**Alt.4**	**Alt.5**	**PA**
1	86	70	57	116	63	58
2	103	75	61	99	58	83
3	112	80	93	113	64	95
4	105	69	67	123	71	90
5	98	64	50	111	70	84
6	107	68	64	106	68	81
7	104	69	57	108	69	96
Average	**102**	**71**	**64**	**111**	**66**	**84**

Note: The rotation length is calculated by dividing the regeneration harvest area divided by the total on-base area in the upland land classes (approximately 831,450 acres). Riparian treatments are considered un-even age management and therefore do not have rotation.
PA = Preferred Alternative

The average rotation length, while may be useful for conveying a general message about an Alternative, hides the detail and variation of site-specific management that an Alternative will implement. Also, an average rotation length is easily misconstrued as a policy objective in itself. None of the Alternatives explicitly state this type of policy objective. The six Alternatives are designed to search for a balance of generating income for the trusts while restoring the forest conditions for habitat conservation.

2.6.4.2 Summary of Proposed Alternatives

As detailed in Section 2.6.2, there are several policy, procedure, and implementation strategy changes for each of the Alternatives (except Alternative 1). Table 2.6-1 summarizes changes that would be necessary if the Board eventually selects an Alternative or a feature of an Alternative. If selected, such changes would become effective following the release of the Final Environmental Impact Statement and closure of the statutory waiting period.

2.6.5 Summary of Environmental Consequences

This section summarizes the environmental analysis detailed in Chapter 4 of the Environmental Impact Statement, which examines the effects of proposed changes to the current policy and procedures under each Alternative. Conclusions are based on reasonably available data and generally qualitative analysis, supported by quantitative data where available and appropriate. Computer model outputs provide useful information that illustrates expected impacts of the Alternatives. The Forest Resource Plan and the Habitat Conservation Plan Environmental Impact Statements provide useful benchmarks for evaluating the effects of the 2003 sustainable harvest calculation level.

Potential relative risks are identified and discussed for the resource areas and are used to rank the Alternatives. The potential relative risks and rankings express the potential for environmental impacts to occur.

None of the Alternatives would result in any probable significant adverse impacts to any of the resource areas, relative to current conditions, beyond those anticipated in the Habitat Conservation Plan. A relatively high risk does not necessarily equate to a probable significant adverse impact when compared to another Alternative or to existing conditions.

2.6.5.1 Forest Structure

This section analyzes the environmental effects on forest structure, old forests, forest health, carbon sequestration, and threatened and endangered plant species. The analysis examines the current and proposed changes to policy and procedures under the different Alternatives. This analysis also assesses relative risks among Alternatives that are illustrated using modeling outputs.

Alternatives 1 and 4 would provide more old forest and would entail less risk of adversely affecting threatened, endangered, and sensitive plant species than the other Alternatives. However, Alternatives 1 and 4 would result in more dense forest stands that achieve lower individual tree growth rates and are more susceptible to damage from insects and disease. Alternative 2 and the Preferred Alternative are ranked intermediate in terms of their overall relative risk of causing negative environmental impacts. The Preferred Alternative has a higher risk associated with it over the short term, but in the long term ranks highest in the development of structurally complex forest stands. Both the Preferred Alternative and Alternative 2 would require an intermediate level of investment for successfully implementing their management strategies and achieving the projected level of harvest.

Alternatives 3 and 5 would have fewer policy limitations for stand management and timber harvest and would apply more intensive management strategies than the other Alternatives. Management proposed under Alternatives 3 and 5 would result in more harvest area and forests that are less susceptible to insect and disease damage.

Alternative 5 and the Preferred Alternative would entail more relative risk of adversely affecting threatened, endangered, and sensitive species of plants due to more harvest and harvest-related disturbance.

2.6.5.2 Riparian

The distribution of stand development stages within riparian areas suggests that compared to historic unmanaged stands, many moderate to large streams on western Washington forested state trust lands may have reduced levels of multiple riparian functions because of decreased levels of large, fully functioning stands. Riparian areas for smaller streams may have adequate shade and size for potential instream large woody debris, but may be deficient in decadent features and other riparian functions important to wildlife and other riparian-dependent species. Many riparian areas currently contain moderate to high levels of early stand development stages, and are not likely to change in the near future. Thinning

can reduce the time necessary to produce very large trees and reduce the time needed to increase stand complexity.

Removing trees within the Riparian Management Zone may temporarily reduce the level of some riparian functions, but the extent of the reduction depends on where trees are removed, site-specific conditions, the amount of trees removed, and the particular riparian function being considered (Washington Forest Practices Board 2001). Such near-term impacts would have to be considered against the potential to accelerate functional recovery. The degree to which moderate intensity timber management would affect near-term riparian function is uncertain. However, active forest management can change species and stand composition and accelerate the development of more complex stand structures (Carey et al. 1996). Such events would help to restore long-term riparian functioning but may have some short-term adverse effects.

Each Alternative proposes different levels of harvest activities in riparian areas (Table 4.3-2). During the remaining period of the Habitat Conservation Plan, Alternatives with lower levels of activity, such as Alternatives 1, 2, 3, and 4, are expected to have a higher proportion of riparian area with large and very large trees that are in competitive exclusion stages. In contrast, Alternatives with higher levels of active management, such as the Preferred Alternative, are expected to have more riparian area that will be fully functioning (descriptions of these stand development stages are provided in Appendix B, Section B.2.3), or be on a trajectory towards full function. Regardless, riparian conditions are expected to improve under all Alternatives relative to current conditions. This is due to changes in stand structure, particularly increases in the amount of stand development stages that include large and very large trees, which are in moderate supply throughout much of the forested trust lands (see Figure 4.3-2). The rate of improvement in structurally complex forests overall is similar among most Alternatives, though the Preferred Alternative performs better through 2067. When looking at the two most complex stages of niche diversification and fully functional forests, the Preferred Alternative accounts for more than 13 percent of riparian areas by 2067 compared to about 7 percent for Alternative 1.

2.6.5.3 Wildlife

None of the Alternatives, including the Preferred Alternative, proposes changes to the northern spotted owl conservation strategy, as outlined in the Habitat Conservation Plan (HCP) on pages IV.1 to IV.19 and IV.86 to IV.106. The HCP Environmental Impact Statement is incorporated by reference and relied on in this Final EIS. In addition, this Final EIS analyzes the Alternatives in light of the new information on northern spotted owl demography discussed in Section 4.4.3 of this document. The analysis also includes a comparison of the Alternatives using three criteria:

- changes in the amount of structurally complex forest ;
- the amount of timber harvest in designated Nesting, Roosting, and Foraging Management Areas and Dispersal Management Areas; and
- changes in the management of owl circles.

Other policy and procedure changes under the Alternatives would influence the amount and distribution of wildlife habitat on forested trust lands. The Alternatives would vary in the timing and amount of forest structures they would create, but would not be expected to have any significant adverse environmental effects on wildlife.

The sustainable harvest calculation analysis uses the stand development stages to represent structural diversity and habitat values (descriptions of these stand development stages are provided in Appendix B, Section B.2.3). Changes in the relative amount of forested habitat types are a product of varying rates and intensities of timber harvest under the different Alternatives. Appendix D, Table D-12 presents the modeled proportion of forested trust lands comprising ecosystem initiation, competitive exclusion, and structurally complex forests under each Alternative in the years 2013 (short term) and 2067 (long term). Competitive exclusion forests are the most common forest habitat type on forested trust lands, making up 68 percent of the total forested area (Table 4.4-1). Approximately 26 percent of this habitat type occurs in Upland Areas with General Management Objectives. Structurally complex forest makes up about 25 percent of the total area on forested trust lands (Table 4.4-1). In the short term and long term, the amount of structurally complex forest is modeled as increasing in all HCP Planning Units under all Alternatives.

The structurally complex forests stages serve as a relative indicator of change in the amount of habitats of management concern. Several examples follow:

- Northern Spotted Owl - Throughout much of their range, northern spotted owls are strongly associated with forested areas that are classified as structurally complex in this Environmental Impact Statement.
- Marbled Murrelet - The Marbled Murrelet Recovery Plan (USFWS 1997) identifies terrestrial (upland) habitat essential for marbled murrelet recovery. The Recovery Plan identifies additional areas on non-federal land where existing habitat should be protected because habitat in federal reserves is insufficient to reverse population declines and maintain a well-distributed population. In the state of Washington, such additional essential habitat occurs on state lands within 40 miles of marine waters. These areas are critical for improving the distribution of the population and suitable habitat, especially in southwestern Washington (USFWS 1997). Effects on forestlands within 40 miles of marine waters, therefore, are of particular concern in determining the effects of the Alternatives on marbled murrelet populations. Of the approximately 340,000 acres of structurally complex forest on forested trust lands (Table 4.4-1), approximately 85 percent occur within 40 miles of marine waters (see Table D-16).
- Deer and Elk - The results from the Washington Forest Landscape Management Project (1996) indicated that the estimated carrying capacities for deer and elk are comparable when either timber production is maximized or when 30 percent of the watershed is maintained in a fully functional forest stage.

Forest in the competitive exclusion stages is currently the most abundant habitat type on forested trust lands. Under all Alternatives, the majority of timber harvest is expected to occur in this habitat type. Two processes would likely affect the amount of competitive exclusion forest: conversion to ecosystem initiation forest through high-volume timber harvest, and development into structurally complex forest through natural forest succession, as well as forest management activities such as thinning.

Model output data indicate that the amount of competitive exclusion forest on forested trust lands would decline under all six Alternatives in both the short term and the long term (Table 4.4-3). In the short term, results show very little difference in the amount of competitive exclusion forest among the Alternatives (Appendix D, Table D-12). Model outputs indicated that at the end of the planning period, by 2067, all Alternatives would reduce the amount of forestlands in competitive exclusion, ranging from 1 to 8 percent. Under Alternatives 1, 4, and 5, approximately 65 percent of forested trust lands would consist of competitive exclusion forest, while Alternatives 2 and 3 would result in about 64 percent. Under the Preferred Alternative, 60 percent of the forested trust lands would consist of competitive exclusion forest (Appendix D, Table D-12).

For the most part, decreases in the amount of competitive exclusion forest correspond to increases in the amount of structurally complex forest. This result suggests that many areas that currently sustain competitive exclusion forest would acquire the characteristics of structurally complex forest over time. The greatest long-term declines in competitive exclusion forest would likely occur under the Preferred Alternative, followed in descending order by Alternatives 1, 4, and 5, and 2 and 3. Declines in the amount of competitive exclusion forest would not be expected to result in any significant adverse effects to wildlife species overall. No wildlife species are found exclusively in competitive exclusion forests, and decreases in the amount of competitive exclusion forest would nearly be matched by increases in structurally complex forest.

2.6.5.4 Air Quality

None of the proposed Alternatives would create new policies or procedures related to air quality. Impacts related to air quality would result from the projected forest management activities associated with each of the Alternatives.

The Alternatives differ slightly in their effects to air quality, but none of the Alternatives has the potential for significant environmental impacts relative to current conditions, beyond those anticipated in the Habitat Conservation Plan Environmental Impact Statement. Air pollution from dust would be mitigated by dust abatement measures under all Alternatives, and the total amount of prescribed burning would likely continue to be below the level anticipated in the Habitat Conservation Plan.

2.6.5.5 Geomorphology, Soils, and Sediment

Significant increases in landslide frequency or severity and loss of soil productivity relative to current conditions, beyond those anticipated in the Habitat Conservation Plan (HCP) Environmental Impact Statement, are not anticipated under any of the Alternatives. Increased soil erosion may occur in certain intensely managed areas as road use increases. Further discussion of relative impacts among the HCP Planning Units and for individual watersheds is included in Section 4.15, Cumulative Effects. The Alternatives are ranked according to percent of uplands impacted per decade by intensity of harvest type (Table 4.6-8). By this ranking, Alternative 5 carries the highest potential overall relative impact, followed by Alternatives 2, 3, the Preferred Alternative, 4 and 1.

The public comments requested that the Final EIS review the differences between Alternatives with regard to forest roads. Section 4.6 presents information relevant to road impacts. In general, it is not expected that the number of road miles or road density will vary as a result of the implementation of any of the proposed Alternatives. While the Final EIS Alternatives propose different harvest timings and locations, the basic road network statewide will evolve to the end condition, over time, virtually independent of which Alternative is chosen. Road spacing is mostly dependent on topography. Topography drives the type of logging system used to achieve the desired silvicultural objectives, which in turn dictates optimal yarding distance to road spacing combinations. This is illustrated by Table 4.6-3 (Section 4.6), "Road Density Analysis by Deferral Class under the Preferred Alternative in 2004." The table shows that there are small differences between road density in areas that would be deferred from harvest under the Preferred Alternative and the areas that would allow activity.

Road impacts for all the Alternatives should be well within the range anticipated by the Habitat Conservation Plan (HCP) due to the relationship to the total acres harvested. As indicated in Table 4.6-4, harvest levels in each of the activity types for each of the Alternatives are within those expected under the Habitat Conservation Plan and analyzed in the HCP Draft and Final Environmental Impact Statement (EIS). The HCP Draft EIS (DNR 1996) analyzes effects related to sediment (p. 4-163) and stream flow (p. 4-170). Mitigation in the form of Riparian Management Zones, management for hydrologically mature forest in the significant rain-on-snow zones, wetland protection, and road management planning (identified above) are detailed in those sections.

The Washington Forest Practices Rules Final EIS (DNR 2001) also presents an analysis of the effects of sediment, peak flows, and roads in Riparian and Wetland Areas on water quality and on fish. A discussion of sediment is contained in Section 3.2 (p. 3-7), which discusses road surface erosion and road-related landslides. The evaluation of the Alternatives in this analysis offers the 2001 rules package that provides measures necessary to address impacts due to road-related sedimentation (p. 3-16). These mitigation measures include implementation of road maintenance and abandonment plans and the adaptive management program. In addition, Appendix F in the Final EIS for the Forest Practices Rules discusses the effects of road construction and maintenance and describes recommended and accepted practices for building and maintaining roads. It states that,

"Roads built following Forest Practices Rules that provide specific direction and recommended Best Management Practices (BMPs) from the literature have the lowest risk of causing sediment delivery" (p. F-2). As stated above, all of the Alternatives will meet the requirements as specified in the Forest Practices Rules.

2.6.5.6 Hydrology

Procedure 14-004-060, which prohibits harvest of hydrologically mature forest in the rain-on-snow and snow zones where the mature forest type makes up less than 66 percent of these zones, would not change under any of the Alternatives. Consequently, significant changes in peak flows due to harvest activities would continue to be avoided under all of the Alternatives. The Habitat Conservation Plan Environmental Impact Statement (DNR 1996) provides more detailed analyses of the effectiveness of the measures laid out in Procedure 14-004-060 and other procedures in minimizing potential adverse effects to peak flows from harvest activities (see Sections 4.2.4, 4.4.3, and 4.8).

2.6.5.7 Water Quality

None of the Alternatives would increase the risk of water quality degradation in the long term. Existing procedures adequately protect water resources. Short-term, localized sedimentation may increase in some areas immediately following harvest, but the vegetation in the inner and no-harvest portion of the Riparian Management Zones would prevent most sediment from entering streams. Over the long term, improved riparian function would likely lead to improved water quality on DNR forested trust lands.

In the short term, additional planning and implementation resources would be required to prevent sediment delivery to streams as a function of greater harvest in the Riparian Management Zones under Alternatives 2 and 3, and, to a greater extent, under Alternative 5 and the Preferred Alternative. However, in the long term, riparian function across the land base is expected to improve more rapidly under the Preferred Alternative than any other Alternative proposed, as discussed in Section 4.3 (Riparian).

2.6.5.8 Wetlands

DNR Forest Resource Plan Policy No. 21 states, "the Department will allow no overall net loss of naturally occurring wetland acreage and function." The procedure (PR 14-004-110 Wetland Management) governs harvest activities in and around wetlands and is not proposed to change under the Alternatives.

The approximate delineation method, an approved approach to determine wetland boundaries, primarily uses maps and aerial photographs. However, not all wetlands, particularly forested wetlands, are visible on aerial photographs. Also, the Habitat Conservation Plan and its Environmental Impact Statement acknowledge that wetlands less than 0.25 acre may be affected by forest management activities. Thus, the difference in environmental impacts to wetlands under the proposed Alternatives would be a function of the acreage to be harvested and the amount of related activities under each Alternative. Over all, Alternative 1 would result in the lowest level of disturbance (an average of 11 percent per decade), followed by the Preferred Alternative, Alternatives 4, 2, 3, and 5 (at

14, 15, 16, and 17 percent, respectively). Alternative 5 would disturb the most acres, an average of 24 percent per decade, and would have the greatest affect on wetlands.

2.6.5.9 Fish

In general, the effects would be expected to follow those described in Section 4.3, Riparian Areas. Over the long term, all Alternatives would be expected to result in improved riparian and aquatic conditions for fish because of increased riparian function associated with continued growth or restoration of riparian stands. Larger and taller riparian tree stands with multiple canopy layers are expected to increase shade levels, functional in stream large woody debris, and leaf and needle litter, and improve coarse and fine sediment input and hydrologic regimes. In part, this would result by recovery from current degraded conditions in many areas caused by practices prior to the Habitat Conservation Plan rather than enhancement of natural conditions.

Relative to Alternative 1 and other Alternatives, the Preferred Alternative is expected to have more beneficial effects by increasing the rate at which riparian stands transition to structurally diverse, fully functioning stands. However, the Preferred Alternative also includes more intensive management of riparian areas for habitat enhancement. Under the Preferred Alternative, management activities would include a moderate level of infrequent, but heavy thinning activities designed to promote structural diversity in competitive exclusion stands that currently dominate in riparian areas. The current and proposed policies and procedures are designed to avoid, minimize, and mitigate for forest management practices on forested trust lands that have the potential to adversely effect aquatic habitat features. On a relative basis, the slightly higher activity levels proposed under Alternative 5 and the Preferred Alternative suggest a slightly higher risk of adverse effects from forest management activities if mitigation measures are followed. Regardless of Alternative, the potential for adverse effects appear to be within levels anticipated under the Habitat Conservation Plan.

2.6.5.10 Public Utilities and Services

This analysis considers the potential effects of the Alternatives on harvest volumes. Volume directly affects revenue to the beneficiaries, and some beneficiaries partially fund public utilities and services with timber revenue. This section also considers the potential effects of the proposed Alternatives on transportation infrastructure. The analysis uses the modeling outputs to inform the public and decision-makers of the relative differences in potential environmental impacts. This analysis also allows DNR to assess relative risks that are illustrated using modeling outputs.

The Alternatives provide a wide array of direct economic benefits to the beneficiaries. In other words, the relationship between the Alternatives is not consistent across all beneficiaries. Projected annual average harvest levels are, for example, highest for Agricultural School Grant lands under the Preferred Alternative, but highest for University Grant lands under Alternative 5. This variation is also evident for State Forest lands when projected harvest levels are viewed by county. Projected State Forest land harvest levels are, for example, highest under Alternative 5 in Wahkiakum County, but highest under

Alternative 3 in Skamania County. These modeling outputs do not provide precise harvest schedules, but they can represent a likely distribution of harvest levels over time at the county level. While they provide an indication of the possible distribution of harvest by county, it is difficult to predict what effect this variation would have on the built environment.

Potential effects on transportation infrastructure would vary by Alternative, with larger projected harvest volumes resulting in increased logging truck traffic. Alternatives with larger projected harvest volumes would, however, also result in more revenue available for maintenance and improvements to public utilities and services. Potential transportation impacts would occur within the context of total forest management activity within the state of Washington and surrounding regions. Current DNR harvests represent about 13 percent of total western Washington harvest. Logging companies harvesting timber from forested trust lands must meet Washington State Department of Transportation weight requirements and pay taxes that support road improvements. DNR regularly meets with local government officials and engineers to discuss the effects of logging-related traffic (DNR 1992b). These measures would help mitigate potential impacts associated with increased road traffic. As a result, none of the Alternatives is expected to result in any probable significant adverse environmental impacts on transportation infrastructure.

2.6.5.11 Cultural Resources

While there are relative differences among the Alternatives, none is expected to result in any probable significant adverse environmental impacts to cultural resources relative to current conditions. Forest Resource Plan Policy No. 24 requires protection of such resources and DNR is committed to consulting with Native American tribes and other interested parties about areas of cultural importance to them. These two forms of mitigation are expected to minimize risk to cultural resources.

2.6.5.12 Recreation

Environmental impacts on recreation resources are assessed in relation to harvest level. More intensive harvest would have a larger impact on the landscape, potentially affecting the quality of recreation experiences in adjacent and nearby areas. Potential effects on recreation may be mitigated on a case-by-case basis during operational planning prior to the initiation of harvest activities. Potential effects may be mitigated by employing harvest systems that minimize potential visual effects and by relocating or rerouting affected recreation facilities, particularly trails, as appropriate. All of the Alternatives would meet the requirements of DNR policies and procedures that address recreation and public access (Policy Nos. 25 and 29). As a result, none of the Alternatives is expected to result in any probable significant adverse environmental impacts to recreation.

The effects of the proposed Alternatives on fish and wildlife could, in turn, affect recreational fishing and hunting on forested trust lands. Fishing and hunting opportunities on forested trust lands could be positively affected to the extent that improvements in habitat and habitat suitability contribute to greater numbers of fish and game populations in some or all of the HCP Planning Units. The potential effects on fish and wildlife are discussed in more detail in Sections 4.10 and 4.4, respectively.

2.6.5.13 Scenic Resources

Lands managed for timber production under all Alternatives would be managed under DNR's visual management procedure (14-004-080), which seeks to minimize potential impacts to scenic resources by managing harvest activities with respect to sensitive viewshed areas. Potential visual effects associated with the proposed Alternatives may be mitigated on a case-by-case basis during operational planning prior to the initiation of harvest activities. Operational planning by the DNR includes policies and procedures related to green-up (growing young trees for a specific time before adjacent trees may be cut), reforestation, and harvest unit size that contribute to the management of forested landscapes. As a result, none of the Alternatives is expected to result in any probable significant adverse environmental impacts on scenic resources.

2.6.5.14 Cumulative Effects

Cumulative effects are defined under both a broad and narrow definition for this analysis. DNR recognizes that cumulative effects conditions are occurring and have the potential to occur in the future in watersheds where DNR manages forested trust lands. The analysis examines current forest conditions, wildlife habitats, fish, water resources, and potential impacts of future harvests. DNR's policies and procedures are in place and implemented to manage and reduce the risk of cumulative effects occurring. The Alternatives with higher levels of activities in the first decade, Alternative 5 and the Preferred Alternative, have a somewhat higher risk of contributing to cumulative effects, especially related to water resources. However, all Alternatives implement various mitigation measures for cumulative effect to forest vegetation, wildlife, and water resources. These measures include, but are not limited to, implementation of the Habitat Conservation Plan (HCP) Riparian Management Zones, procedure for management of potential slope instability, visual area management, procedure for adjacency of regeneration harvest units, and a leave trees strategy. The expectation is that the overall level of cumulative effects would be reduced under all Alternatives in the future due to the Board of Natural Resources forest management policies; DNR's HCP and operational procedures in combination with Forest Practices Rules; the Northwest Forest Plan; and other regional programs, such as salmon recovery efforts (Salmon Recovery Funding Resource Board), and HCPs developed by private forestry companies (e.g., Plum Creek, Port Blakely, Simpson Timber, West Fork Timber) and utility companies (e.g., City of Seattle, Tacoma Water). These programs should reduce the potential for future cumulative effects by requiring that landowners do their share of mitigation and avoidance. All of the proposed Alternatives would be expected to provide effective mechanisms in policy and procedures to provide mitigation against cumulative effects where DNR manages a portion of the landscape.

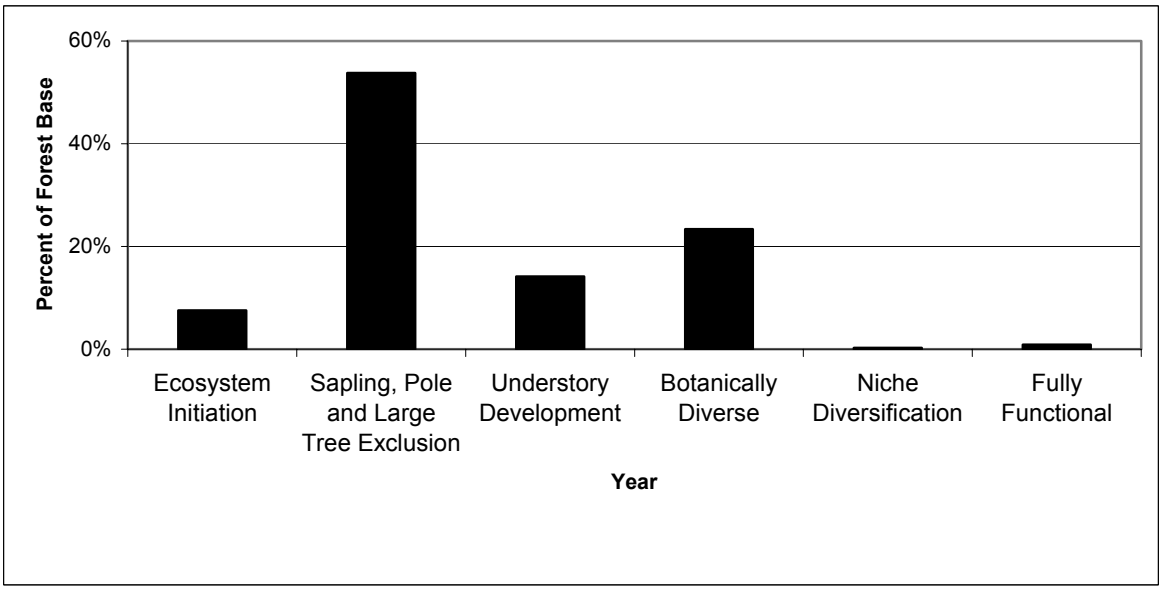

Figure 2.6-2. Modeled Proportion of Forested Trust Lands Forest in Each Stand Development Stage in 2004

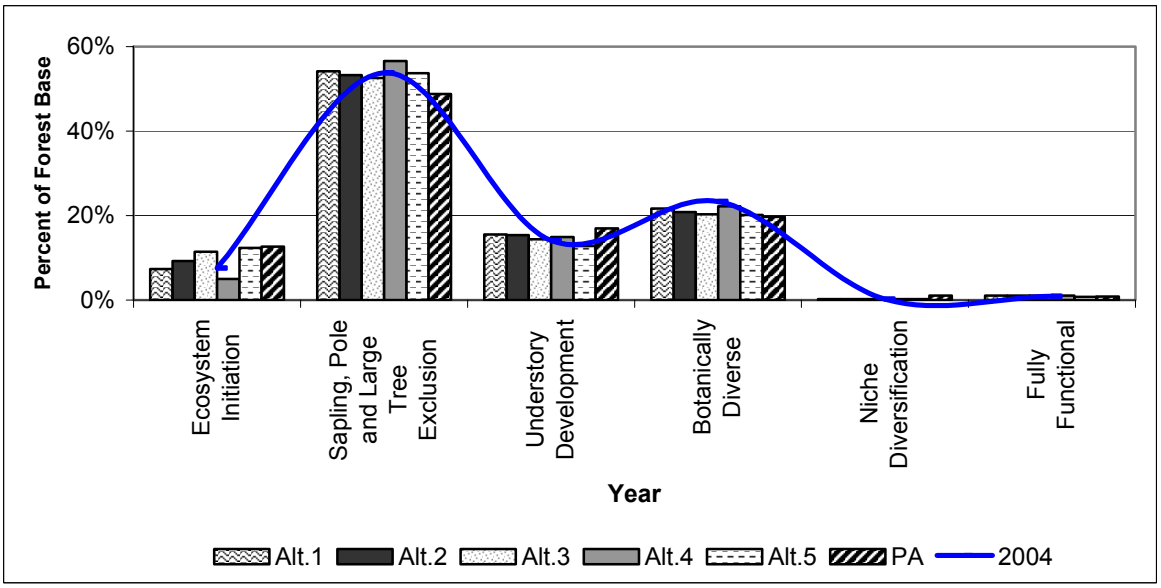

Figure 2.6-3. Modeled Proportion of Forested Trust Lands Forest Stand Development in Each Stage in 2013 by Alternative

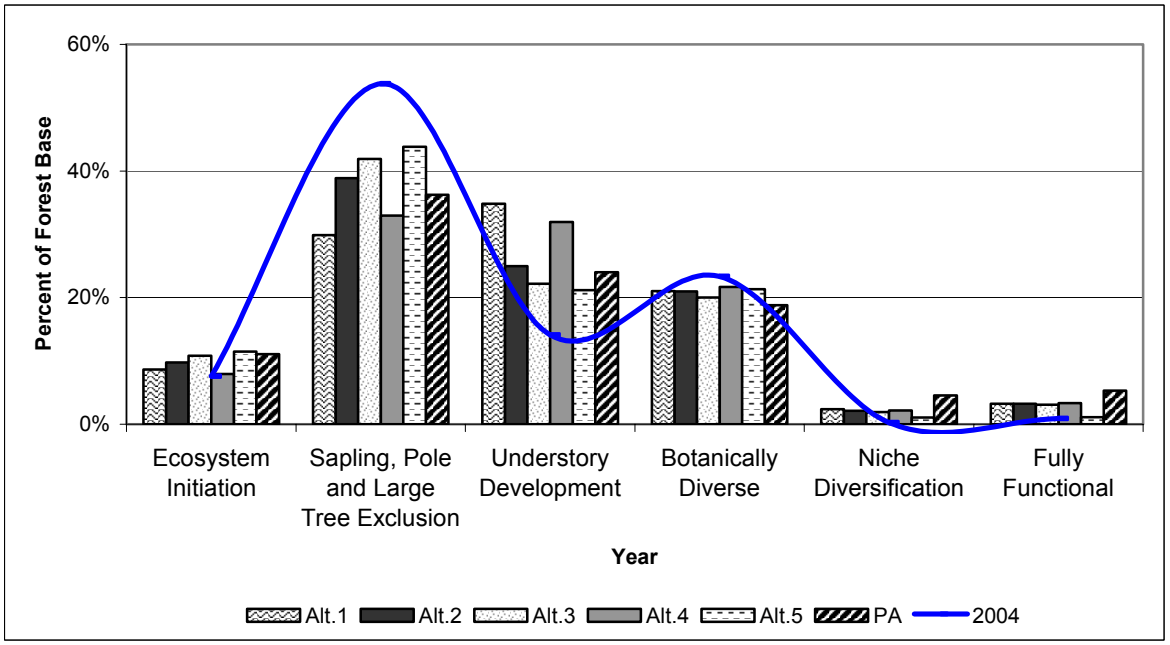

Figure 2.6-4. Modeled Proportion of Forested Trust Lands Forest Stand Development in Each Stage in 2067 by Alternative